The American Journal of Surgery

NEW SERIES, VOL. XXVI NOVEMBER, 1934 No. 2

EMPYEMA

REPORT OF 351 CASES TREATED BY A CLOSED NEGATIVE PRESSURE METHOD*

RALPH F. HARLOE, M.D., F.A.C.S.

BROOKLYN, N. Y.

EMPYEMA, or more properly, suppurative pleuritis, is, in almost all instances, a complication of pneumonia. There is always some degree of pleuritis present in every pneumonia, and it is not strange that a fairly large number of these become suppurative. It is true that a great many more suppurative pleurisies occur than are supposed or recognized. This truth is proved at the autopsy table.

Other causes may be those secondary to penetrating thoracic wall injuries, intrapleural rupture of a lung abscess, and surgical contamination during thoracentesis. More rare are those cases developing from subphrenic or mediastinal suppurations.

Aside from these latter causes, we associate empyema with the pneumonia patient, and should regard every pneumonia as a potential empyema, particularly those cases where the temperature remains elevated for a longer period than is usual for pneumonia.

A protracted or so-called "unresolved" pneumonia generally means suppuration.

Several years ago a medical and radiographic study of pneumonia in infants was made by Dr. Carl Laws and Dr. Alfred L. L. Bell, of Long Island College Hospital. Each pneumonia patient admitted to the pediatric service of the hospital was radiographed daily.

In those cases of protracted pneumonia where the continued elevation of temperature was not caused by a definite massive empyema, tuberculosis, middle ear or other complications, the radiograph showed an interlobar shadow of varying dimensions, which persisted for several days, only suddenly to disappear partly or entirely within twenty-four hours, followed by a decline in temperature to near normal.

The sudden and rapid disappearance of the interlobar shadow was evidently due to rupture and drainage of a small interlobar empyema (Fig. 1) into a bronchus, the small quantity of pus present being swallowed because of the inability of the infant to expectorate it. If these areas of opacity were caused by unresolved pneumonia, the disappearance of the shadow would be gradual and require several days for complete absorption.

The term "unresolved" pneumonia should therefore be employed with discretion in protracted cases, especially in infants and children. It is far better to discard the term and think of empyema.

Davison[1] states that the wrong conception of unresolved pneumonia is the

* From the Surgical Service of the Long Island College Hospital.

outstanding cause of most of the failures to diagnose empyema.

Why one patient will develop empyema,

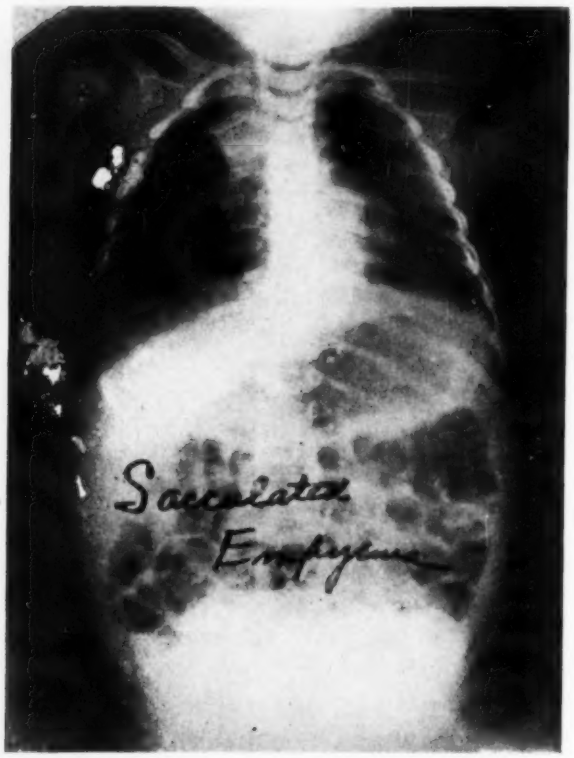


Fig. 1. Sacculated empyema. Recovery following rupture into a bronchus.

whereas a second patient with apparently an identical condition will not, has not been definitely determined.

Moschowitz[2] advances the theory that empyema may be caused by infection of a pleural effusion, by the rupture of a small subpleural abscess. Many others adhere to the theory of infection of the pleura by direct extension of the infectious process from the lung, or believe that the bacteria may reach the pleural space through the blood stream. Allen[3] stressed the importance of hemothorax as an etiological factor of empyema. He prepared a twenty-four hour blood-agar culture of hemolytic streptococcus obtained from a patient with acute empyema.

In his first group, the pleural cavity of 9 rabbits was injected with the streptococcus culture together with from 0.5 to 2.0 c.c. of autogenous blood. All of these 9 rabbits developed empyema. In 11 other rabbits a saline suspension of the streptococcus culture was injected without the intentional injection of blood. Of these 11 control animals, only 3 developed empyema. The remaining 8 were killed and at autopsy showed surprisingly normal pleura and lungs, both when examined grossly and microscopically. None of the 8 had empyema.

In a second group, a saline suspension of a virulent forty-eight hour blood-agar culture of Type III pneumococcus was injected into the pleural cavity of 6 rabbits. In 3 of these, 1.0 c.c. of autogenous blood was also injected. All 6 rabbits died within five days, but only those 3 in which blood had been injected showed empyema, while the remaining 3 showed a normal pleural space at autopsy, and the pneumococcus was recovered from the surface of the pleura in 2 of them.

In a third group, a saline suspension of a thirty-six hour blood-agar culture of Type I pneumococcus was injected into the pleural cavity of 18 rabbits. In 10 of these, 1.0 to 2.0 c.c. of autogenous blood was also injected immediately after the injection of the pneumococci. All 10 rabbits developed empyema and died. Of the remaining 8, 2 died and only one had empyema. The remaining 6 were killed, and none had developed empyema.

These animal experiments have shown that blood in the pleural space in the presence of bacteria was a factor in the production of empyema.

A small spontaneous hemorrhage may occur in the pleural cavity of the pneumonia patient, by the extrusion of blood into the pleural space from rubbing together of the inflamed pleural surfaces, or blood may enter through rupture of a small vessel of the inflamed pleura as the result of violent coughing. If bacteria are present, empyema may follow.

If we accept Allen's experiments and clinical observations as convincing, how many empyemata are produced as the result of blood entering the pleural space following injury to the pleura by an

aspirating needle during exploratory thoracentesis? The careless practice of passing a long aspirating needle deeply into an infected lung, and contaminating the pleural space on withdrawal of the needle, or the introduction of bacteria from without by non-adherence to strict surgical asepsis, are possibilities in causing empyema. Careful technique is most important.

Fabris,[4] in a study of empyema in the newborn, states that empyema can be primary and may fail to present the usual early and premonitary pulmonary symptoms. He reports Hervieux's 7 cases, Miquot's 5 and Mace's 3, in which the disease was apparently due to an infection which, by an unknown pathogenesis, attacks the pleura. All of these cases of empyema were without concomitant pulmonary lesions, and were apparently the result of a general infection which does not give rise to pulmonary symptoms, but whose manifestations are referable to the gastrointestinal tract.

An infant ten days of age is the youngest patient the writer has ever treated for empyema. The child showed no clinical evidence of pneumonia. At the time of operation, 50 c.c. of thin pus was obtained, the culture showing non-hemolytic streptococcus. The infant was extremely toxic and unable to retain food. It died four days following operation.

DIAGNOSIS

Suspect empyema in all protracted pneumonias. Examine the patient daily. Lack of thoroughness in this examination, and inability to correctly interpret physical signs, are the chief reasons for failure to detect a pleural effusion, whether serous or purulent. Suspicious symptoms are: fever of the septic type, sweating, especially in infants, cough, rapid pulse and respiration. The patient gradually becomes pale and presents a decidedly septic appearance. Leucocytosis is persistent.

The physical signs may vary, depending upon the location and volume of the effusion. There is definite impairment of resonance or complete dullness in some part of the chest, most frequently at one or both bases. Breath sounds over the affected areas are absent or diminished. In infancy and childhood, tubular breathing is frequently found over the site of an empyema. Vocal fremitus is diminished or absent. The heart is often displaced, and there is lagging of the affected side on inspiration.

In large effusions the physical signs are adequate, but in encysted or interlobar types where the diagnosis is in doubt, repeated radiographs should be made, supplemented by exploratory thoracentesis, for without these aids a positive diagnosis may be impossible.

A diagnosis of empyema should never be attended by failure, when resort is made to the every-day methods at our disposal.

Every case of empyema must be individualized and carefully and patiently studied. Each will show some variation, such as character and virulence of the infection, condition of the patient, or associated complications, such as bronchial fistula, pneumothorax or pulmonary abscess. Age is an important factor.

TYPES OF EMPYEMA

The types of empyema complicating pneumonia, given in their order of frequency, are: massive or general, interlobar, sacculated, bilateral and necessitatis.

TREATMENT

With so large a number of variable conditions possible, the treatment of empyema should necessarily differ in several details in certain instances.

During a so-called influenza epidemic, such as that witnessed in 1918, we are dealing with an especially virulent type of streptococcus, where the pleural effusion appears within two or three days following the onset of pneumonia. The mortality always is extremely high, as many of these patients quickly die of septicemia or bilateral massive consolidation, and at necropsy often show multiple small ab-

scesses of the lung, which, on culture, are found to contain streptococci.

After several days, when the pneumonic infection of the lungs should improve, these patients are still very ill, and a major operation of any type should not be considered, other than frequent, careful, slow aspiration of fluid in small quantities, until the patient's general condition has improved.

If these patients are going to improve, they will do so without early operation for the relief of empyema. Where death follows, it is not because of empyema, but may be due to operative shock, acute cardiac failure, septicemia, suppurative pericarditis or meningitis.

A great number of the *epidemic* streptococcic pneumonias develop empyema, and the effusion collects rapidly, many times in enormous quantities. In other non-epidemic cases, we frequently find a moderate streptococcic empyema in which a pure culture of pneumococcus has been obtained from the sputum. These patients are not nearly so ill, and rarely require preoperative aspiration for relief of cardiac or respiratory distress.

Numerous procedures for the surgical management of empyema appeared in medical literature. A great number of these reports dealt with various modifications of the older methods, while others described newer treatments. But few of these authors, however, have continued their study of empyema or offered subsequent reports to substantiate their original observations.

We find many exponents of a closed operation. Mozingo[5] was one of the first to report a series successfully treated by a closed method.

Due to familiarity with the method of costectomy and because of the inertia of custom, a large number of surgeons still adhere to this method, or to that of open intercostal drainage.

A departure from these forms of treatment is frequently described.

Flesch[6] effected a cure of an empyema by resorting to Makai's method of injecting subcutaneously pus withdrawn from a child whose entire right pleural space was filled. Thirteen punctures were made at four and a half and six day intervals, over a period of eight weeks. Each time 0.25 to 1.0 c.c. of pus was injected into the back. He reports complete recovery without any other treatment.

In a second case, that of an infant aged six and a half months, nine injections were given during a period of five weeks. In both patients the pus disappeared from the pleural cavity.

It requires courage to thus experiment with a treatment that for several weeks exposes a patient to constant absorption of toxins from an undrained empyema, especially when dealing with infants of tender age where early drainage is most essential for recovery.

The method is reviewed not to stimulate further experiments upon similar lines, but to discourage adoption of any treatment experimental in nature, where it involves infants and young children. Too long exposure to absorption of toxins from an undrained empyema in very young infants is usually fatal, and it is difficult to conceive of a cure in the above cases where no other treatment was given.

Leitner[7] states that optochin (ethyldrocupreine) has an elective action upon the pneumococcus. He does not employ costectomy because of high mortality in children. His treatment consists of early aspiration of all fluid, avoiding pneumothorax, and irrigating immediately with half per cent solution of warm, fresh, sterile optochin until the return fluid is clear, using 30 to 40 c.c. at a time. The amount usually required is from 60 to 200 c.c. He then injects 5 per cent optochin of sufficient quantity to give a dose of 25 mg. per kilo of body weight. This corresponds to one-half the daily dose. The maximum dose is 0.5 gm. or 10 c.c. of 5 per cent solution. The injections are repeated every three to four days until

aspirated fluid is sterile. This requires about one month. He reports 7 cures in 8 cases, one being tuberculous. He refers to Ozembowski who tried the method in 1915, also to Gulka who mentioned it in 1922 but abandoned it because of its bad effects, producing blindness and deafness in several cases.

This form of treatment has recently been reported by several German and French writers, and it appears that ill effects are produced from overdose. Leitner, by his regulation of dosage to body weight, seems to have overcome the toxic manifestations of the drug. The small number of cases reported and the dangers likely to follow the use of this chemical by those inexperienced in its application, should contraindicate its employment as a routine treatment of pneumococcus empyema until more complete data are available.

Berghard[8] reports poor results with costectomy or thoracotomy, and prefers puncture. In 17 cases treated by frequent puncture, 8 were cured while 9 died, a mortality of 53 per cent. Three of his patients were under four months of age. The mortality with costectomy and thoracotomy may have been greater, if the choice is a method which gives a mortality of 53 per cent.

The uncertainty of cure, and at times the high mortality, should not popularize this method of treatment. While a number of cases have been reported which have been successfully treated by frequent aspiration, they are generally children, and the empyema is usually sacculated or interlobar.

Several years ago, one of the writer's patients, an infant aged seven months, presenting an interlobar empyema, was treated by aspiration, 15 c.c. of pus in all being withdrawn. Following removal of the pus, 10 c.c. of 2 per cent mercurochrome was injected and the needle then withdrawn. The following day mercurochrome appeared in the expectorations of the infant, in the stools, and later, the entire side of the chest became bright red from deposit of the chemical in the skin. The child showed no untoward symptoms and recovered without further treatment.

Schaedel[9] is also an exponent of the conservative method of frequent puncture. He reports 5 cases successfully treated, but makes no mention of the number of unsuccessful results. He states that rib resection causes increased pathology, but should be done if necessary.

Soresi[10] describes a special cannula with a valve attachment which opens on expiration. The pus is permitted to discharge into a small bottle attached to the cannula. The cannula is unique, but is not applicable to all types of empyema. It cannot be employed to advantage in multilocular empyema or a small sacculated empyema situated beneath the scapula. In infants, the narrow intercostal spaces necessitate costectomy in order to insert the cannula. This is a disadvantage.

As no irrigation is done postoperatively, thorough drainage must at times be obstructed by fibrin in certain pneumococcus empyemas. The cannula is removed in from six to twelve days, and the pleural cavity injected with a stimulating antiseptic paste.

Alexander and Sherk[11] state that in the treatment of empyema every precaution should be taken to avoid prolonged drainage and to prevent scoliosis. Their method of treatment as outlined in their series, consisted of rib resection following several aspirations. No reference is made as to the time of operation. Irrigation was not a regular part of the postoperative treatment, and recovery as a rule was slow. The anesthetic was either ether, nitrous oxide-oxygen, ether-gas-oxygen or local. The mortality in 291 cases of all ages up to twelve years, was 18.5 per cent. Sixteen of the patients were one year or under, and their mortality was 56.2 per cent.

In upper respiratory infections ether is contraindicated as an anesthetic, and in two of the cases above reported, in which ether was employed, pneumonia developed. Scoliosis is common in many instances

where costectomy has been performed, and 2 cases in their series required institutional treatment by orthopedic surgeons for the relief of this condition.

Bettman and Crohn,[12] for treatment of acute empyema complicated by bronchial fistula, employ the closed method without irrigation, but with water seal adjustment, and find this has been most beneficial in that type of case. They stress the fact that a patient with empyema is never cured until the empyema cavity has been obliterated.

Sarnoff[13] has recently adopted a closed method of treatment, employing a special oval trocar, size 24, which he states passes more readily through narrow intercostal spaces. A tube as large as a No. 24 is not necessary to successfully irrigate an empyema cavity. A round trocar of the proper size for children and infants should be employed. The pressure of a catheter as large as a No. 24, when maintained in the narrow interspaces of these small patients, is likely to cause pressure necrosis of the encroaching rib margins, probably later necessitating extrapleural costectomy. This complication occurred in 4 of the writer's early cases, when only a No. 18 trocar and catheter were employed for all ages.

Packard,[14] employing drainage and irrigation with Dakin's solution, treated 50 cases of empyema in children with a mortality of only 2 per cent. He believes that closed drainage meets its greatest indication in children.

Krasnobajev and Freidin[15] review the mortality in 353 cases of empyema treated in the period from 1904 to 1924. In 280 cases a thoracotomy was done, employing local anesthesia. The mortality in 38 of the children under one year of age was 73.6 per cent, 76 between one and four years of age (37.1 per cent), 132 between four and nine years (23.3 per cent), and 34 between nine and twelve years, a mortality of 14.7 per cent. This treatment was later supplemented by repeated punctures and aspirations. Fifty-two cases were treated, 26 of which resulted in complete healing. The remaining 26 cases were subjected to secondary thoracotomy. This mortality is much too high.

Noeggerath[16] employed intercostal pleurotomy in all children under his care, and states that in comparison to other methods the therapeutic result of the pleurotomy with subsequent drainage is especially favorable in very young children, and recommends that this treatment be applied in adult cases.

Davies[17] believes that in all cases in which costectomy is performed, there is danger of fragments of bone falling into the pleural cavity, and of rib necrosis due to contamination of discharging pus. To prevent the latter, he resorts to blocking of the cut ends of the rib with sterile bone wax before the parietal pleura is opened.

Ladd and Cutler,[18] in the treatment of 268 patients, elected to operate upon 42 of these by the closed method. Of this number 12 died, a mortality of 28 per cent. Twenty-one of these cases, or 50 per cent, required secondary operations to adequately drain the empyema. The mortality in these 21 cases was 9½ per cent. Four per cent of the cases required secondary operation for obliteration of the cavity. Ether anesthesia was used in 150 cases. Of these, 27 patients died, a mortality of 17.64 per cent. Forty-five operations were performed under procaine-epinephrin anesthesia with 10 deaths, a mortality of 22.22 per cent. Fifty-eight patients were given nitrous oxide and oxygen anesthesia, with 9 fatalities, a mortality of 15.51 per cent. Their unsuccessful treatment by the closed method is unusual, as this method has so often been found to give the lowest mortality rate, and if properly performed should never require secondary operation.

One of the later methods reported is that of treatment by periodic aspiration with air replacement, carried out by Danna,[19] and appears to give excellent results in many cases. He reported 35

consecutive cases treated by this method. He does not mention the length of time required for cure, or the complications that may follow the use of this method.

Bloch and Parrish [20] employ this method in children. They report 14 patients treated, ranging in age from six months to seven years. These children received from two to nine tappings, and the febrile course ran from nine to one hundred and three days, the latter exceeding by over twenty-five days, the next lowest, the average being thirty-four days. The number of drainage days varied from four to one hundred and one. Cellulitis of the chest wall was a complication in 2 cases. Two of the entire series were under one year of age, one of which died, a mortality of 7.41 per cent. There is no report as to follow-up examinations on these patients, to determine whether it was later necessary in some, to resort to costectomy to effect a cure. In a pneumothorax where sterilization is not complete, it has been my experience that recurrences are likely to take place. The foregoing technique has apparently worked ideally in a large number of cases of empyema, but it has certain disadvantages, among which are the possibility of a tension pneumothorax resulting from rupture of a small cortical abscess, causing communication between a bronchus and the pleural cavity.

Spontaneous pneumothorax may very often appear, even after any type of closed drainage, due to this complication.

In very young infants it is imperative that the pleural cavity be freed entirely of pus, and kept free by some irrigation method. Long contact of pleural surfaces with purulent exudate is a constant source of toxemia, and these little patients cannot tolerate this for long without a toxic acidosis supervening, with its possible fatal outcome.

WHEN TO OPERATE

This depends upon the age, the condition of the patient, and type of operation to be performed. An empyema of streptococcus origin is frequently synpneumonic. A staphylococcus empyema may be of the hemolytic variety, and may at times appear early, but usually forms after the pneumonia has been in progress for several days. Pneumococcus empyema usually occurs later. In this type, the pneumonia has nearly subsided and the patients are less toxic and not as critically ill as those with a streptococcus infection.

If costectomy is contemplated, it should be delayed until such time as the patient's condition has improved sufficiently to withstand the shock of such an operation, with its accompanying pneumothorax. It is best to resort to frequent aspirations if it is necessary to relieve cardiac or respiratory embarrassment.

It is poor surgical judgment to perform costectomy upon an infant, an aged patient, or one critically ill with an active pneumonia, profound toxemia, or circulatory involvement. The operative mortality must necessarily be high, and these should be classed as typical empyema deaths.

There are numerous instances where surgeons may employ a closed operation to be followed later by costectomy. Where irrigation with Dakin's solution is employed, immediately after operation, it should not be necessary to resort to costectomy. If however, irrigation is not done, the closed operation is little better than intercostal incision, being of no value in the presence of large accumulations of fibrin.

The writer has employed a *closed negative pressure* operation with irrigation, whether dealing with interlobar, massive, or bilateral empyema. It was not necessary to perform costectomy for the treatment of acute empyema in any of these cases. None reached a chronic stage, which later necessitated radical costectomy for the obliteration of a persistent cavity.

Chronic unhealed empyema has never followed, excepting 6 cases of advanced tuberculosis. The closed operation renders unnecessary repeated aspirations during the course of the pneumonia, and may be

performed at any stage, especially in the early streptococcus empyemas, without waiting for the pleural exudate to become thickly purulent, adhesions to form, or the patient's condition to improve. Here, the operation is curative as well as palliative, causing no greater shock than the insertion of an aspirating needle. It quickly removes the source of the toxemia, and permits the lung to expand to its normal position.

Many of the children in this series were very poor operative risks, and the mortality percentage would have been considerably higher if any other than a closed form of operation was employed.

In 1919 the writer reported 13 of these cases treated by the closed method.[21] Since that time, details of the treatment have been more thoroughly worked out, and the method is here given in a more comprehensive form.

CLOSED NEGATIVE PRESSURE IRRIGATION TREATMENT

When a patient is presented for treatment, a roentgenogram is taken if possible, to determine the type of empyema. This however, is not always essential. The details of the technique employed in the treatment reported in this series are as follows:

Exploratory Thoracentesis:[22] The patient lies upon the unaffected side and a thorough preparation of the skin over the side of the empyema is made, first with alcohol followed by 3 per cent iodine or kalmerid solution. The patient is properly draped and a site selected for the insertion of the needle for exploratory thoracentesis. If a general empyema exists, an area corresponding to the seventh or eighth interspace on the posterior axillary line is anesthetized with 1 per cent novocaine solution, being careful to infiltrate the subcutaneous tissue including the costal pleura. After waiting two or three minutes, an aspirating needle attached to a 20 c.c. Luer syringe is slowly passed through the chest wall, at the same time making constant traction upon the piston of the syringe.

When the needle enters the pleural cavity and pus appears in the barrel of the syringe, the needle is grasped between the thumb and first finger, close to the skin, and withdrawn. The distance from the finger tips to the point of the needle is then noted, to determine the depth at which pus was found.

A small stab wound is made through the skin, of sufficient width to permit the passage of a No. 14, 16 or 18 trocar, depending upon the size and age of the patient. If the trocar is sharp, the incision with the knife need not pass through the entire thickness of the chest wall. If this is done however, the flat surface of the knife should be held in relation to the borders of the ribs, and incision made nearer the upper border of the rib, so that when the tube is in position it is less likely to encroach upon the intercostal nerve of the adjoining rib.

A trocar and a cannula (Fig. 2) suited to the size of the patient are selected, and the tip of the trocar after being dipped in sterile vaseline, is gently and slowly passed through the prepared opening in the chest wall, to a depth corresponding to slightly more than the distance measured off on the aspirating needle, at which pus was found. The trocar is removed and the thumb of the left hand quickly placed over the cannula to prevent rapid ejection of pus.

A special empyema catheter (Fig. 3) containing four openings about 1.5 cm. apart and with the distal end of the catheter firmly clamped, is held in the right hand, and as the left thumb is withdrawn from the opening in the cannula the catheter is quickly passed through the cannula into the pleural cavity, for a distance of about 5 inches. If the outer end of the cannula is deflected downward, the direction which the catheter follows is toward the apex of the lung. This position is to be desired, especially if fibrin is present.

The cannula is now removed, being careful to place a clamp behind the cannula before the outer clamp is removed.

Pus is now *slowly* withdrawn by means of a 50 c.c. Luer syringe, clamping the tube each time that the syringe is disconnected, to prevent air from entering the pleural cavity.

In very sick patients, particularly those where the empyema may be in the early formative stage, not more than 100 to 150 c.c. of pus should be removed at the time of operation, the remainder being withdrawn in quantities of 25 to 50 c.c. every four hours, until no more fluid remains. This permits gradual readjustment of the thoracic viscera to its normal position, without the shock attending sudden change of pressure, which would follow too rapid or sudden removal of the pus.

Irrigation: After all pus has been withdrawn, regular irrigations are begun, employing warm, sterile, normal saline solution for the first twenty-four hours, after which Dakin's solution is employed, unless contraindicated by the presence of a bronchial fistula, in which event the use of saline solution is continued.

In irrigating the empyema cavity, no more than 15 to 25 c.c. of solution should be injected at one time when treating infants and young children. With adults, 25 to 50 c.c. may be employed. The use of a greater amount should be avoided, as it causes separation of the two pleural surfaces at each irrigation, thereby preventing desirable pleural adhesions.

Each irrigation should be thorough, continuing until the return washings are clear. They are repeated every two hours during the day, and every four hours during the night, for the first forty-eight hours, after which time the interval should be changed to every four hours during the day and twice during the night. Always handle the end of the empyema tube with sterile gauze, to prevent contamination.

The clamp should not be removed at any time, unless the opening in the tube is connected to the syringe.

The patient should have a completely expanded lung, if all the details herein outlined are strictly adhered to.

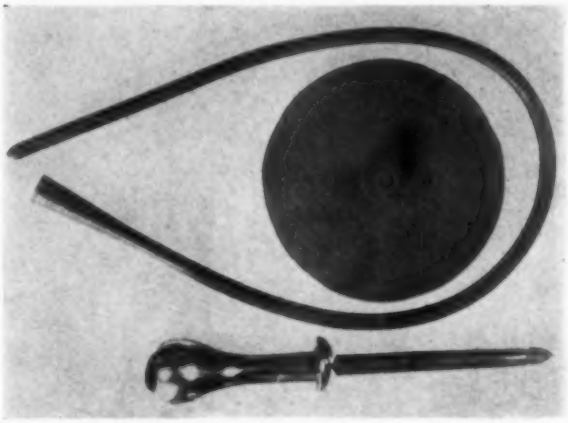


Fig. 2. Type of trocar and cannula with empyema tube and disk employed for support of tube. Note that part of funnel end of catheter has been removed so that catheter will fit a 50 c.c. syringe without use of an adapter.

Fibrin: In some instances, particularly the early cases of pneumococcus origin, it will be noted that after part of the pus has been withdrawn, the openings in the tube will become occluded by particles of fibrin. By forceful injection of 10 c.c. quantities of normal saline solution, the fibrin is forced out of the openings in the tube. If *very* gentle traction is now made upon the piston, pus will appear in the syringe. This procedure may be repeated several times until the amount of fibrin drawn about the inner end of the tube increases, rendering it impossible to withdraw even the saline. Now slowly inject 75 c.c. of Dakin's solution and clamp the tube, allowing the Dakin's solution to remain in the pleural cavity. At the end of three hours it will again be possible to withdraw pus. Repeat this procedure every three hours until the tube no longer becomes obstructed, showing that the fibrin has been completely dissolved. This may require from twenty-four to fifty-two hours.

The tube is held in place by means of a special rubber disk (Fig. 2).

A clamp sufficiently long is passed through the previously moistened opening

in the disk and the end of the tube drawn through the opening, manipulating the clamps so that air does not pass through

always be protected by being wrapped in a piece of sterile gauze, held in position by a special clamp. These may be made by

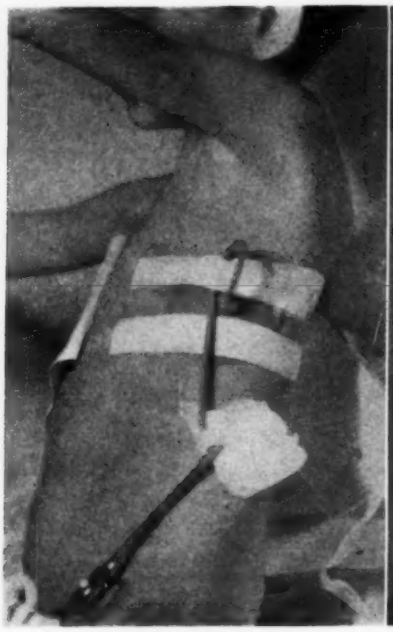


Fig. 3. Fig. 4.

Fig. 3. Child with an empyema located along lateral chest wall, with tube at selected site. Note manner in which tube is looped and held by adhesive strip to prevent traction at point of exit of tube through disk.

Fig. 4. Completed dressing with combines, held in position by two adhesive straps folded back about 5 inches over tongue depressors.

the tube into the pleural cavity. Holding the tube firmly, wet its outer surface and carefully slide the disk along the tube until it reaches the skin, where it is pressed firmly and held in place by two strips of adhesive plaster (Fig. 3) 6 inches long and ¾ inch wide.

Be careful to observe that there is no angulation of the tube beneath the disk. The tube is now looped (Fig. 3) and held against the dressing by a narrow strip of adhesive plaster. Any traction on the tube caused by the patient moving about, or during irrigation, will be resisted at this point and will prevent the tube from being pulled out of the pleural cavity. Gauze and a large combine cut half way across are now placed upon the disk, so that the tube and clamp rest on the outer surface of the combine. Adhesive straps 4 inches wide, folded over a tongue depressor, are tied over the clamp by means of tape (Fig. 4). The end of the catheter must

grinding down the inner surface of the clamp so that when it is closed at the first notch, there will be a space between the ends. These ends are then covered by small pieces of rubber tubing to prevent the tube from being cut when the clamp is locked.

Removal of the Tube: The time for removal of the tube varies from two to six weeks, and is determined by the patient's temperature and the quality of the return washings from the pleural cavity. Added complications and the patient's recuperative ability also influence the time factor. The first irrigation given in the morning is observed. If the return fluid becomes clear after the second or third injection of solution, the tube may be removed, and in its place a rubber tissue drain inserted through the sinus by means of a curved probe, the drain being ½ inch in width and 3 inches in length, with a safety pin passed twice through the outer end to prevent the drain

from slipping into the pleural cavity. This drain maintains a patent sinus in the event that it again becomes necessary to insert the tube for further irrigation.

The dressings are now examined each morning, and the character and amount of the discharge noted. For the first two days it will be rather profuse, but thereafter should gradually diminish until there is but a spot of dried exudate ½ to 1 inch in diameter on the dressing. At this time the drain may be removed and the sinus permitted to heal.

The patient should be kept under observation in the hospital for another week, and if there is no elevation of temperature and roentgenogram shows no reaccumulation of fluid, he may be discharged and examined once weekly for four or five weeks.

The method of follow-up is to give the patient an *x*-ray request slip, dated six months from the time of discharge from the hospital. In this manner it has been possible to obtain follow-up examinations on nearly all of these cases.

The duration of treatment by this method, varies from eighteen days to eight weeks, and depends upon complications and in a large measure upon how faithfully and completely irrigations have been carried out.

PYO-PNEUMOTHORAX

Pneumothorax associated with empyema may result from several causes; introduction of air through an aspirating needle during exploratory thoracentesis or during repeated aspirations carelessly performed. Air may also enter the pleural cavity through a bronchial fistula. This occurs frequently in empyema which is interlobar in origin, or may be secondary to lung abscess, the abscess eroding through the wall of a bronchus into an interlobar fissure. If the bronchial fistula is large, air is drawn into the pleural cavity in inspiration, and, owing to the valve-like closure of the fissure during expiration, the air cannot escape. This influx of air continues until the intrathoracic pressure is sufficiently high to prevent separation of the margins of the fissure during inspiration.

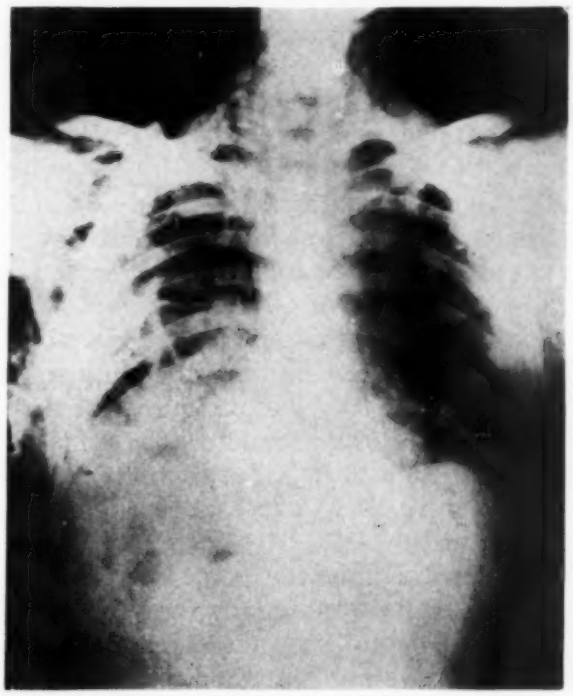


Fig. 5. Subcutaneous emphysema following exploratory thoracentesis in patient with tension pneumothorax resulting from bronchopleural fistula.

The condition is really one of tension pneumothorax, and if an aspirating needle connected to a Luer syringe were to be inserted through the thoracic wall above the layer of fluid, the piston of the syringe would be rapidly forced outward.

The presence of these bronchial fistulae escapes detection when costectomy is performed for the relief of empyema. Failure of early re-expansion of the lung in open operation may in part be attributed to delayed closing of a large bronchial fistula.

Pneumothorax may also accompany effusions in which gas-producing anaerobic organisms are present.

Empyema patients with compression pneumothorax show marked respiratory and cardiac embarrassment. The mobility of the mediastinum in early empyema permits pressure to be exerted upon the lung of the unaffected side, equal to that on the affected side. In these conditions,

operative mortality is most likely to occur if costectomy is performed and the tension too suddenly relieved.

When the closed method of operation is performed as herein described, gradual withdrawal of the pus relieves the pressure upon the lung, and air is again drawn into the pleural cavity through the bronchial fistula. This is immediately followed by subcutaneous emphysema (Fig. 5), air entering the tissues as the result of a break in continuity of the parietal pleura following insertion of the trochar. Pus entering emphysematous tissues is likely to produce a diffuse cellulitis of the chest wall. and if anaerobic bacteria are present it spreads rapidly, resulting in marked sloughing and profound toxemia, becoming so severe as to cause death in nearly all cases.

The treatment at this point is important. When subcutaneous emphysema appears, the clamp should immediately be removed from the tube and not replaced. This will permit air to pass in and out through the tube during respiration. Collapse of the lung will follow, and is to be desired, as it places the lung at rest and favors closure and healing of the bronchial fistula after several days.

During this period the pleural cavity is regularly and slowly irrigated three times daily with warm sterile saline solution. Here, as in all cases where a bronchial fistula is present, Dakin's solution is contraindicated. Should it enter the open bronchus, the sudden paroxysm of coughing which follows causes the patient to gasp and become cyanotic, presenting a picture of profound distress.

After ten days the tube may again be clamped, and no air permitted to enter the pleural cavity at any time. Continue the saline irrigations, and after three of four days have a roetgenogram made of the chest, for comparison with the one taken a day or two following operation. If the bronchial fistula has healed, the lung will show increased expansion. Gentle irrigation of the pleural cavity may now be safely carried out with Dakin's solution, avoiding too great traction on the piston of the syringe for fear of re-opening the bronchus.

EMPYEMA COMPLICATING FETID LUNG ABSCESS

Occasionally we encounter empyema secondary to fetid lung abscess, where, due to rupture of the abscess into the pleural space adjacent to the abscess, pyothorax results. Pneumothorax is always a factor, being produced either by air entering through the abscess via the bronchus, or by gas formed by various types of anaerobes which abound in these infections. In either instance, it is possible that there may be displacement of the thoracic viscera toward the unaffected side, with its accompanying tension pneumothorax.

These patients are critically ill, the profound toxemia associated with cough, dyspnea and general weakness, presenting a picture entirely different from that observed when lung abscess or empyema occur alone.

Here we must select a method of treatment that will relieve both conditions, and at the same time safeguard the life of the patient. The two-stage operation for lung abscess is impossible and costectomy for drainage of the empyema is too severe a shock for the patient to withstand.

Treatment: 1. Relief of the empyema by inserting an empyema catheter into the pleural cavity through an intercostal space at the most dependent point, preferably on the posterior axillary line, slow withdrawal of the pus by means of a 50 c.c. Luer syringe, following which the pleural cavity should be cleansed by repeated irrigation with warm normal saline solution.

The tube should not be clamped at any time during or after the removal of the pus, for the following reasons: A bronchopleural fistula may or may not be demonstrated on irrigating with saline solution. If, however, it *is* present, a clamped tube means tension pneumothorax with its associated complications already described.

In the absence of a bronchopleural fistula, the open tube permits collapse of the affected lung, placing it at rest and approximating the walls of the lung abscess.

Three times daily from 20 to 50 c.c. of warm saline solution are slowly injected through the tube, and not withdrawn by the syringe, the saline being permitted to discharge into a basin or later into the dressings. Repeated traction on the piston of the syringe tends to prevent healing of the fistula.

2. Remove all pillows and place the patient in the Trendelenburg posture by elevating the foot of the bed about 12 inches. This facilitates drainage of the lung abscess. The degree of improvement may be noted by measuring the amount of expectoration before and on each day following operation. A daily decrease in the volume of sputum, and a decline in temperature, are the usual results of the establishment of drainage of the lung and of the pleural cavity.

3. With the lung at rest for from ten to fourteen days, the bronchial fistula may have healed. This is determined by injecting 100 or 200 c.c. of normal saline solution into the pleural cavity, and gently withdrawing it with the syringe. If the patient does not cough, we may cautiously substitute Dakin's solution for the saline, and begin routine irrigations. The tube may now be clamped while the syringe is being emptied and refilled. This permits gradual expansion of the lung until it again entirely fills the pleural space. Comparative roentgenograms of the chest should be made every five days, to note changes in the lung. Increased aeration and diminution of parenchymal infiltration, associated with a steady decrease in the volume of sputum, plus fall in temperature, are the best indication of a favorable prognosis.

When cough and expectoration have ceased, the foot of the bed may be lowered and the patient permitted to have a pillow. Irrigations of the pleural cavity should then be continued as described in the treatment of empyema.

In this series, four cases of lung abscess complicated by empyema were cured, the empyema by irrigation and the lung abscess by postural drainage.

Medication should be prescribed as indicated, but the best support is furnished by blood transfusions of from 250 to 450 c.c. every five days, as long as the patient's general condition warrants.

Pulmonary suppuration and empyema may occur, in which drainage of the abscess through a bronchus is insufficient, even with the patient in the Trendelenburg position. Bronchoscopic dilatation of the bronchus is then indicated. This may produce the desired result, and drainage may then be sufficient to bring about a cure of the lung abscess. In the event of failure of the abscess to drain adequately, one is confronted by an uncommon situation, a poorly draining lung abscess plus an infected pneumothorax.

These patients are unable and should not be permitted to harbor a poorly drained lung abscess over too long a period, without surgical relief.

We should consider costectomy, with insertion of two tubes into the pleural cavity, one for drainage, the second a catheter for irrigation. The lung abscess may now be opened.

This procedure naturally necessitates drainage of the lung abscess into the already infected pleural cavity. Frequent irrigation with saline solution through the tube previously inserted should keep this cavity comparatively free from the accumulation of pus, thereby lessening the degree of absorption of these profoundly toxic products.

EMPYEMA NECESSITATIS

This type results from failure to diagnose empyema, and after several months or more, perforation of the thoracic wall from within follows.

Pus is discharged through the interspace, collects beneath the skin and subcutaneous

soft tissue and forms a localized fluctuant tumor (Fig. 6). The skin over this area may or may not be reddened. Perforation

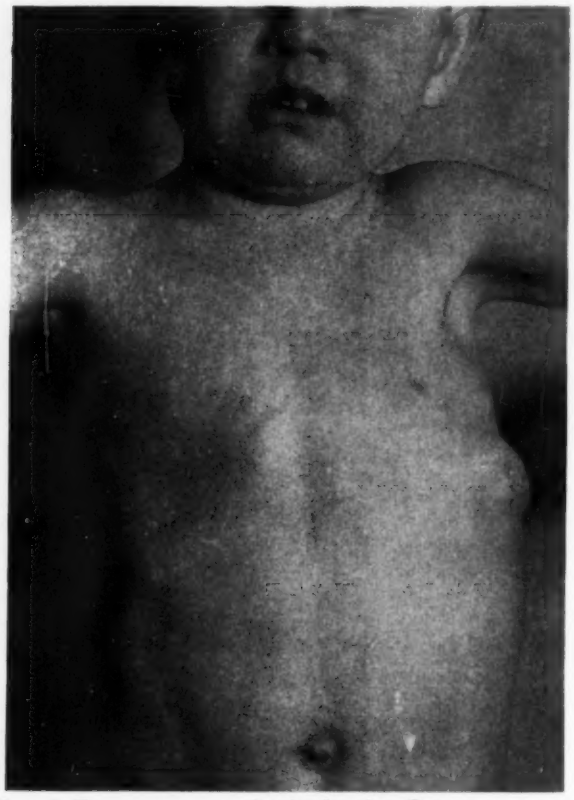


FIG. 6. Empyema necessitatis showing fluctuant tumor on anterior axillary line. Note deepened left axilla as result of scoliosis and retraction of ribs on affected side.

usually occurs near the anterior axillary line in the fifth to the seventh intercostal space, because at this area the thoracic wall is thinnest.

Pathology: In every case of empyema necessitatis, there is a progressive scoliosis with the convexity of the spine directed toward the unaffected side. This scoliosis may be so marked as to cause flaring of the ribs (Fig. 7), the intercostal spaces being so narrowed that the passage of an aspirating needle is extremely difficult. It is frequently noted that there is a compensatory lateral curvature of the lower thoracic and lumbar vertebrae, in the opposite direction (Fig. 8).

Close proximity of the rib margins necessitates removal of a small portion of rib, in order that a tube may be inserted for drainage and irrigation.

The pleura is markedly thickened from its long contact with pus. The lung has been compressed and is now held firmly around its periphery by the densely thickened pleura.

Following costectomy, when healing about the drainage tube is well established, a No. 18 empyema tube with disk should replace the drainage tube.

Irrigations are then carried out four or five times during the day, as in the closed method.

Between irrigations the empyema tube should be connected to a longer tube which passes into a water seal bottle.

The patient is then supplied with a rubber air ring for blowing exercises, in preference to a pair of blow bottles, which are so frequently pushed off the bedside table and broken.

The combined blowing exercises and routine irrigations will tend to bring about thinning of the pleura with resultant lung expansion, and diminution of the pneumothorax.

These patients should be subjected to long treatment, in order to obviate the necessity of radical costectomy for obliteration of the pneumothorax.

BLOOD TRANSFUSIONS

I have found that postoperative blood transfusions from carefully matched donors have been the best added therapeutic measure in the convalescence of empyema patients, children in particular. These transfusions are given in varying amounts, as little as 50 c.c. in young infants, and repeated every fourth or fifth day, as indicated.

Occasionally a patient may run a consistently elevated temperature between 100° and 101°F. daily, although the roentgenogram shows good lung expansion and no sacculated and undrained areas of pus. It is surprising to note that following transfusions the temperature rapidly falls to normal and remains there. These blood

transfusions supply the necessary stimulus that the patient requires in overcoming his infection.

The bacteriological findings in certain years or seasons vary. Often, during the fall and winter months the pneumococcus

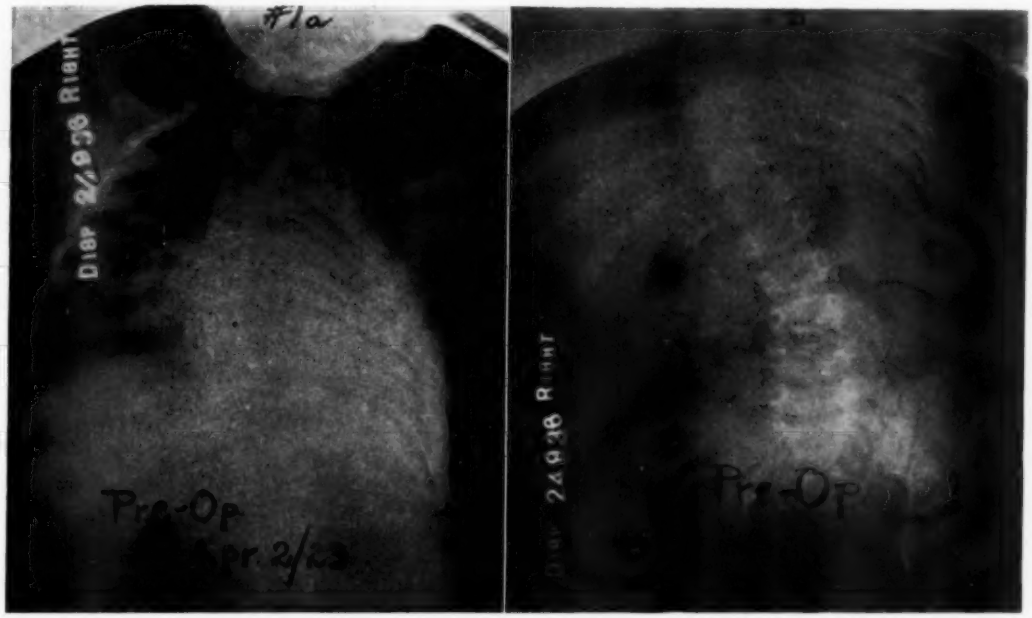


Fig. 7. Fig. 8.

Fig. 7. Empyema necessitatis before operation, showing scoliosis with beginning flaring of ribs along lateral chest wall.

Fig. 8. Empyema necessitatis, showing compensatory curvature of lower spine in opposite direction.

BACTERIOLOGY

The bacteriology in this series of cases is worthy of description. The usual organism is a pneumococcus of Type I, II or IV, streptococcus or staphylococcus. Occasionally there may be a mixed infection and we find a staphylococcus or a streptococcus associated with a pneumococcus. In all cases where the bacillus influenza is associated with any of the above organisms, the patients are desperately ill. Type III pneumococcus empyemas are fortunately not common, but when present the prognosis is grave.

There are three outstanding cases in this series, in which the infecting organism is unusual. One, a pure culture of B. influenza, the second a pure culture of typhoid bacillus, and the third a pure culture of Staphylococcus albus, the last following a septicemia caused by the same organism.

may be the chief organism found, and will run a straight series of the Type I variety. A year later during the same season, the prevailing type may be Type IV. In the spring seasons the prevailing organisms are most often either a streptococcus or a hemolytic staphylococcus aureus.

In the series here reported, 351 cases were treated between 1919–1933 at the Long Island College Hospital, by the closed method herein described. Of this number, there were 233 children with a mortality of 9.87 per cent, and 118 adults with a mortality of 9.32 per cent.

TYPES

Practically all types of empyema are included in this series, and are given in the order of frequency on page 246.

The bilateral empyemas numbered 8 (Fig. 9), 6 of which were infants or children, and 2 adults. Of these 8 cases, 2 of the

children died, a combined mortality of 25 per cent. All of these cases except one, in which the patient died before operation,

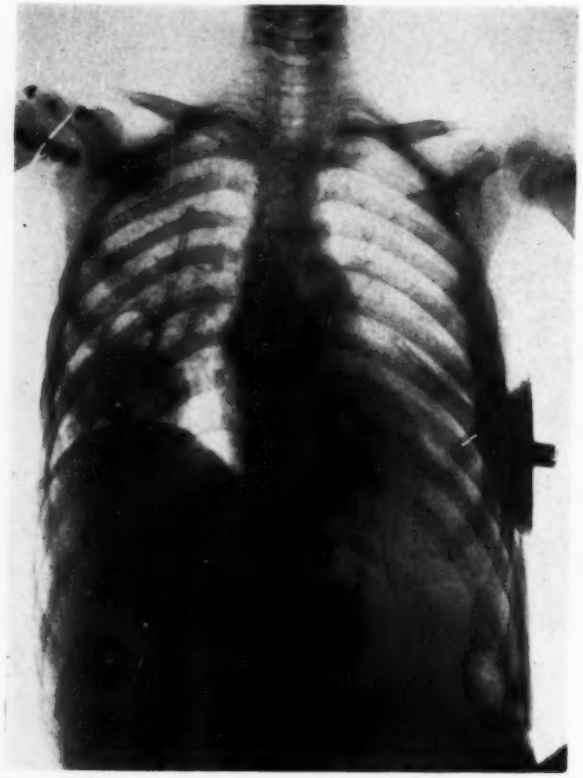


Fig. 9. Bilateral empyema revealing tube in each pleural space. Note complete expansion of both lungs.

were treated by the closed method, both sides being operated upon simultaneously.

Types

	Per Cent
Massive or general	76.86
Sacculated or interlobar	18.55
Bilocular	2.32
Bilateral	2.27

Empyema necessitatis (Fig. 6) was found in 2 cases of massive empyema, one child and one adult. Both recovered. Tuberculosis was active in 6 cases. Of this number, one recovered and 2 died. The remaining 3 left the city and no follow-up record was obtainable.

Fetid lung abscess was the etiological factor in 4 cases of this series. Two were massive and 2 sacculated. In the latter 2, costectomy was performed, the pus being too dense to drain through the small catheter. Irrigation, even with saline, was impossible because of the proximity of a bronchial fistula.

Of the sacculated type, one was successfully treated by one aspiration.

CAUSES OF DEATH

When a patient suffering from empyema dies, death should rarely be due directly to the empyema, unless the treatment has been poorly administered.

Most empyema deaths are caused by: Meningitis or septicemia, which may be secondary to lateral sinus thrombosis, multiple abscesses of the lung, associated simple putrid lung abscess, suppurative pericarditis, suppurative peritonitis, diffuse cellulitis of the chest wall from infections by anaerobic organisms. In this series, one death resulted from this last complication.

Mortality Chart

CHILDREN

Age	*Number*	*Deaths*	*Per Cent*
1 year or under	20	6	30.0
1 to 2 years	50	6	12.
2 to 4 years	69	7	10.14
4 to 6 years	53	2	3.77
6 to 8 years	26	1	3.85
8 to 10 years	7	0	0
10 to 12 years	8	0	0
Total	233	22	9.87

ADULTS

12 to 14 years	5	0	0
14 to 20 years	27	2	7.4
20 to 30 years	34	1	2.94
30 to 40 years	24	4	16.6
40 to 50 years	19	2	10.05
50 to 60 years	4	1	25.
60 to 70 years	4	1	25.
70 to 80 years	1	0	0
Total	118	11	9.32

CONCLUSIONS

1. The closed method, as described, is devoid of the slightest degree of shock.

2. It may be employed in the treatment of any type of empyema where the pus is accessible to the aspirating needle.

3. Costectomy for the relief of chronic empyema will never be necessary if the

closed operation is properly performed and postoperative supervision faithfully observed.

4. In bilateral empyema, both sides may be successfully operated upon simultaneously by no other than the closed method.

5. Collapse of the lung is avoided.

6. In very ill patients, where a large effusion appears early while the pneumonia is still active, application of the closed method and removal of small quantities of fluid every few hours is the choice over frequent aspiration. Due to early irrigation following this procedure, the degree of toxic absorption is greatly reduced.

7. Patients are comfortable and do not require frequent changing of saturated, foul-smelling dressings.

8. Lung abscess complicated by empyema may require no other treatment than the closed method, with open tube plus postural drainage. In this type, death often rapidly follows costectomy, due to shock in an extremely toxic and emaciated patient.

9. In infants one year or under, operation should be performed as early as possible, without waiting for the effusion to change into thick, creamy pus. Observance of this rule is rewarded by lowered mortality.

10. A patient operated upon by the closed method should not die from empyema. When these patients die, the cause of death is due to a complication such as lateral sinus thrombosis, meningitis, septicemia, suppurative pericarditis, suppurative peritonitis, or pneumonia, or, in the case of infants one year and under, in addition to these complications, death may be caused by acidosis resulting from toxemia and inability to retain food.

11. The closed method of treatment is not a drainage, but an irrigation method.

12. There is no evidence of organic scoliosis so often observed in those patients who have been subjected to costectomy. When the details of the closed method are faithfully carried out, it will not be necessary to resort to costectomy.

13. Chronic unhealed empyema is never a factor. The operative wound heals within two or three days following removal of the rubber tissue drain, and the scar is very small. If the lung has been maintained in expansion there will be no recurrence.

REFERENCES

1. Davison, R. E. Treatment of acute empyema. *Atlantic M. J.*, 29: 304–307 (Feb.) 1926.
2. Moschowitz, A. V. Newer conceptions of pathogenesis and treatment of empyema. *Am. J. M. S.*, 159: 669 (May) 1920.
3. Allen, D. C. Hemothorax in idiopathic and postoperative empyema. *Surg. Gynec. Obst.*, 45: 23–34 (July) 1927.
4. Fabris, S. Purulent pleuritis in the new-born. *Pediatria*, 35: 23–35 (Jan. 1) 1927.
5. Mozingo, A. E. The surgical treatment of empyema by a closed method. *Am. J. M. Sc.*, No. 590, 676–694 (May) 1921.
6. Flesch, H. Die Autopyotherapie der Sauglingsempyeme. *Monatschr. f. Kinderh.*, 37: 149, 1927.
7. Leitner, P. Treatment of pneumococcal empyemas with optochine (ethylhydrocuperiene). *Budapesti Orvosi Ujsag.*, 25: 1277–1283 (Nov. 10) 1927.
8. Berghard, E. Etiology and therapy of empyema in infants. *Ztschr. f. Kinderbielk.*, 156, 1926.
9. Schaedel, H. The management of empyema. *Bruns' Beitr. z. klin. Chir.*, 137: 751, 1926.
10. Soresi, A. L. Late results in empyema thoracis in children operated on by the author's method. Am. J. Surg., n.s. 1: 68–75 (Aug.) 1926.
11. Alexander, E. G., and Sherk, R. L. Empyema in children. *Atlantic M. J.*, 29: 602–607 (June) 1926.
12. Bettman, R. B., and Crohn, N. N. Treatment of acute empyema complicated with bronchial fistula; use of closed method. *J. A. M. A.*, 91: 1967 (Dec. 22) 1928.
13. Sarnoff, J. An oval trocar in closed thoracostomy for empyema. *N. Y. State J. Med.*, 31: 635–636 (May 15) 1931.
14. Packard, G. B. Jr., Empyema in children. *Colorodo M. J.*, 23: 88–93 (March) 1926.
15. Krasnobajev, T., and Freidin, J. The results of the treatment of acute empyema in the Morosov Children's Hospital. *Verbandl. d. 16 russ. Chir. Kong.*, Moscow, 1925, p. 358.
16. Noeggerath, C. Simplified treatment of empyema in children. *Muncben. med. Wcbnscbr.*, 78: 303–342 (Feb. 20) 1931.
17. Davies, H. M. Remarks on empyema thoracis. *Brit. M. J.*, 1: 569–610 (April 4) 1931.
18. Ladd, W. E., and Cutler, G. D. Mortality from empyema in children. *Surg. Gynec. Obst.*, 39: 401–542 (Oct.) 1924.
19. Danna, J. A. Principles involved in treatment of empyema thoracis, with particular reference to treatment by periodic aspiration or evacuation, with air replacement without drainage. *Surg. Gynec. Obst.*, 56: 294–309 (Feb.; No. 2A) 1933.
20. Bloch, H., and Parrish, P. L. Acute pyothorax; treatment of children and infants by aspiration of pus and air replacement (pneumothorax). *Am. J. Dis. Child.*, 46: 518–521 (Sept.) 1933.
21. Harloe, R. F. Treatment of empyema. *J. A. M. A.*, 73: 1874–1877 (Dec. 20) 1919.
22. Harloe, R. F. Exploratory thoracentesis. Am. J. Surg., n.s. 6: 433–434 (April) 1929.

SUPPURATIVE PLEURISY*

E. K. TANNER, M.D., F.A.C.S.

BROOKLYN, N. Y.

PERHAPS an apology is due for presenting so commonplace a subject as empyema of the pleural cavity, or suppurative pleurisy as it is sometimes and more properly called, but it is frequently of value to reconsider a commonplace condition in order to see where we stand and determine if we are making progress. I doubt if there is another surgical condition in which the mortality rate has been lowered in the last quarter century as much as it has in suppurative pleurisy, unless it be in diseases of the prostate, and in both of these conditions the progress has been due not so much to new methods of treatment as to a better appreciation of how to protect the patient.

My interest in reviewing this subject was aroused by reading several reports of empyema statistics giving mortality rates which seemed too high. The present paper is founded on a study of cases on the surgical division at The Brooklyn Hospital since the beginning of 1920, about fourteen years. A rather long period is essential to a fair summary because of the fact that the disease varies in severity in different years. There are 207 cases in this series and it includes the work of a number of surgeons.

The majority of cases of suppurative pleurisy are secondary to respiratory infections, either bronchitis or pneumonia, and it is the belief of the writer that most of these are the result of cortical abscesses of the lung which rupture into the pleural cavity. The deep lung abscesses not infecting the pleura belong in a different group as far as treatment is concerned and are omitted in this discussion as are also the tuberculous pleurisies secondary to pulmonary tuberculosis.

For convenience of study the cases fall into three groups: (1) those secondary to acute respiratory disease; (2) those secondary to chest trauma (gunshot, stab wounds and crushing injuries), and (3) those incidental to a general septicemia.

The first group is by far the largest and most important. The causative organisms are varied but are mainly the pneumococcus and streptococcus, and the bacteriology is a factor to be considered in handling the patient as will be shown later.

In this series were 189 cases following respiratory diseases, 5 following chest trauma, and 13 incidental to general septicemia (Table 1).

TABLE 1

Age (Years)	*Group 1*		*Group 2*		*Group 3*	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Under 1	16	0	0	..	0	
1–2	23	2	0	..	0	
2–5	45	4	0	..	0	
6–10	23	0	1	0	0	
11–20	27	1	0	..	0	
21–30	17	1	3	0	6	3
31–40	17	1	1	0	3	2
41–50	12	3	0	..	2	1
Over 50	9	2	0	..	2	2
	189	14	5	0	13	8

MORTALITY

By groups	7.4%	0%	61.5%
All cases			10.6%
Mortality excluding group 3			7.2%
Children under 14 years (116 cases, 6 deaths)			5.1%
Children under 2 years (37 cases, 2 deaths)			5.4%
Children under 1 year (16 cases, no deaths)			0%

DIAGNOSIS

It would be a waste of time to go into the details of the diagnosis of suppurative pleurisy, but it is important for every physician who treats a case of pulmonary

* From the Surgical Division of The Brooklyn Hospital.

infection to keep in mind the fact that a suppurative pleurisy may develop and to be constantly on the watch for it, and especially so when the progress of the sickness is irregular, showing a tendency to be unduly prolonged, or to show exacerbations with a more septic type of fever after partial subsidence. In addition to the classical signs of pleural effusion found on physical examination, the *x*-ray is of the greatest value in determining its exact location and extent and whether single or multiple pockets are present, and it will often locate small areas not to be diagnosed by other methods. When the presence of effusion is diagnosed there arises the question as to whether it is pus or serum. Many times the course of the disease will answer this question.

The aspirating needle is a positive and valuable aid, but unfortunately not without grave danger. Many of us, especially those whose experience extends over many years, have seen cases where a pleural effusion was diagnosed, an aspirating needle used and clear serum obtained, but a second aspiration a few days later obtained pus, and we congratulated ourselves on our wonderful persistence in keeping at it till the pus was found. We know now that some of these patients never would have had the pus except for the needle. This does not mean a faulty sterilization of the instrument or of the skin, but instead a release of bacteria from the infected lung through puncture of the, up to that time, intact visceral pleura, by the sharp needle point.

TIME OF OPERATION

In this day the presence of fluid in the pleural cavity does not constitute an emergency and many a case of simple pleurisy with effusion is allowed to go on to recovery without ever being aspirated, so long as the fluid is not of sufficient amount to embarrass respiration. The fact is recognized that the outpouring of the fluid is a conservative act of nature to separate irritated surfaces and act as a splint for an inflamed lung. The same is true also of suppurative pleurisy to an extent, not that it is self-healing, but that it does not call for an emergency operation. Within the memory of the writer of this paper a patient might be brought into the hospital with pus in the pleural cavity, rushed to the operating room, a piece of rib resected and a gush of pus obtained, to the great satisfaction of the operating surgeon and the admiring audience, in spite of the fact that the patient went into immediate collapse on the table and if he lived to get back to his bed, often did not occupy it long. In those days the mortality of empyema was close to 50 per cent and higher, especially in very young children. In fact a report from the Babies Hospital[1] in New York, dated about 1913 gave the mortality in babies under two years of age as 66.8 per cent. That means that two out of every three died. An institution at the present time with such a rate would be classed as a slaughter house.

While delay in operating is now recognized to be often for the good of the patient this is not by any means to be interpreted as indicating that operation is to be postponed indefinitely, but it does mean a watchful waiting for the best time to operate, and this period of watchful waiting is to be occupied in using every means available to get the patient into the best possible condition. Postponement of operation beyond the optimum period is only a little less dangerous than operating too soon, as it exposes the patient to the dangers due to long-continued sepsis with its effects on the vital organs and blood impoverishment and also its tendency to produce greatly delayed healing because of the thickened pleura and fixed lung which will not expand when the pus is evacuated.

All will agree I am sure that when a diagnosis of empyema is made, the patient should either be in a hospital or at least in frequent contact with the surgeon who is to assume the responsibility of

deciding when and how to operate, for he is the one who will be blamed if things do not go well. How then shall we determine the best time for operation?

One cardinal principle, with few exceptions, is to wait until the causative pneumonia, in cases which follow this disease, has subsided. This is especially important because a patient with an active pneumonia is always a bad operative risk and also because any sudden alteration in intrathoracic pressure is very disturbing to an infected lung. There is also the probability that even with the best of care enough air will enter to produce a pneumothorax with further pulmonary collapse which might be serious if the opposite lung is pneumonic. Of course when the amount of fluid is so great that it is causing actual disability, with displacement of the heart and mediastinum, it is necessary to correct this. Here careful aspiration is the procedure. This may need to be repeated, and occasionally several times before conditions are right for operation. It is here that the type of infection becomes an important factor as pneumococcus infections run a comparatively short course and form frank pus rapidly, whereas in streptococcus infections not only does the pneumonia run a long course but pus develops slowly and there is a large amount of serous effusion as a rule which may remain in a seropurulent state for a long period before becoming frankly purulent. It is this type especially that may need several aspirations to relieve pressure before the proper time arrives for drainage. A fair indication in this type of case is given when the pus becomes thick. It should then be drained. Another very important reason for watchful waiting is to permit firm adhesions to form between the visceral and parietal pleura in order that there will be a minimal amount of collapse of the lung when drainage is instituted. Without these adhesions there is very liable to be complete collapse of the lung when the chest wall is opened, with more serious consequences to the patient, and also requiring a very long time to obtain complete expansion again with obliteration of the empyema cavity. No type of closed drainage with suction can insure against this collapse.

A third important reason for waiting is to permit the patient to develop, as fully as possible, antibodies in his blood, to fight the infection. This is a reason which all surgeons are coming to recognize as important in any suppurative conditions in the body, in selecting the best time for drainage. The old dictum: "When pus is diagnosed, evacuate it," is now accepted only with modification as to time of evacuation.

OPERATION

Having determined the proper time of operation, how shall this be done with a maximum of benefit and a minimum of injury to the patient?

A general anesthetic should never be used for an acute case both because the patient is in no condition for an inhalation anesthetic, and because it is unnecessary. Local anesthesia is perfectly satisfactory.

TABLE II
ANESTHETIC

	Group 1	*Group 2*	*Group 3*
Local	146	2	8
Gas	26	1	3
Ether	21	1	1
Ethylchloride	5		
Combined	2		
Avertin	2		

As to type of operation and its after care, most surgeons now agree that a simple thoracotomy puncture with insertion of a drainage tube between the ribs should practically always be the first procedure, so done that the pus will escape very slowly. If there is a large collection of pus with marked collapse of the lung and displacement of the mediastinum this thoracotomy should be preceded by an aspiration to evacuate a large share

of the pus. Thus the patient is safeguarded from the shock of a sudden readjustment. If the patient is very sick the thoracotomy can be done perfectly well in his bed with very little disturbance. This insertion of a drainage tube can be done very simply by using a trocar and cannula just large enough to allow the drainage tube to pass through it easily. Under local anesthesia a short slit is made in the skin and the trocar and cannula pushed through between the ribs. The trocar is then removed and the drainage tube slipped through the cannula and the cannula removed. It is well to have a mark on the tube at a definite distance from its end so the operator may be sure just how far it enters the thorax. This makes a practically air-tight drainage for several days, until the wound has suppurated enough to enlarge the opening.

Often this simple thoracotomy tube drainage is all that is needed, but it should not be adhered to too strongly. If the drainage is not adequate and the condition is not steadily improving, there should be no hesitation in doing a rib resection later when the patient's condition has improved. This also can be done perfectly well under local anesthesia.

As to the method of establishing and maintaining drainage much has been written in recent years, especially since the World War. Many of the methods advocated have hinged upon some form of positive suction to empty the cavity and hasten lung expansion. In this group of procedures belong various forms of vacuum suction, siphonage, tidal irrigation with siphonage and others of similar type. The idea has much to recommend it, but many of the methods suggested have been very complicated, requiring elaborate apparatus and skilled constant attention in their working. This is always a disadvantage and gives too many chances of a slip somewhere which interferes with efficiency. Complicated apparatus should always be avoided unless it has very material advantage in shortening the period of morbidity. We maintain that none of the methods suggested do this to a sufficient degree to compensate for the extra labor and watchfulness required to maintain them. Especially is this true in young children whom it is practically impossible to keep quiet enough to maintain attachment to a suction apparatus.

What might be termed passive suction is a much simpler procedure. By this I refer to methods aimed at allowing pus to escape freely but preventing air from entering the cavity, thus favoring lung expansion.

Gibson,[2] of New York, has advocated a flap operation, dissecting up a flap of skin and subcutaneous tissue and making the opening between the ribs in such a position that it will be covered by the flap. He inserts a strip of rubber dam to maintain drainage and claims that the skin flap prevents entrance of air. The trouble with this method is that if granulation is active the wound will close too rapidly. An equally efficient and better method consists in cutting the drainage tube off nearly flush with the skin surface and fastening a piece of rubber dam so that it will fall over the end of the tube, making a "flap valve." This permits the pus to flow out with each respiratory expansion of the lung but the rubber tissue is sucked against the end of the tube with each retraction and prevents air entering. Lilienthal[3] makes a very simple and efficient modification of this method by tying over the end of the drainage tube an ordinary rubber finger cot and making a slit in its end. This makes a very satisfactory flap valve.

It has been our experience however that provided the time of operation has been chosen wisely and the case has been so managed that the lung has become firmly adherent to the chest wall, even these various forms of special technique are unnecessary. The patients usually do about if not entirely as well by simple drainage into dressings. The dressings should be changed frequently to prevent

skin irritation and if the patient is old enough to cooperate, some form of lung expansion, either forced deep breathing at frequent intervals, or blowing exercises of some form aid materially in expanding the lung. These can be made interesting in various ways, especially for children: the Wolff blow bottles, blowing up rubber balloons or even blowing soap bubbles. A special refinement for older patients is a spirometer by which they can themselves watch their gain in lung capacity.

TABLE III
TYPE OF OPERATION

Aspiration only	6
Thoracotomy	78
Rib resection	169
Aspiration for diagnosis not counted, nor simple dilatation of sinus	
Thoracotomy requiring later resection	26

TABLE IV
CULTURE REPORTS

	Group 1	*Group 2*	*Group 3*
No record	28	2	5
No growth	38	1	1
Pneumococci	59	0	1
Streptococci	42	0	1
Staphylococci	25	3	2
Colon bacilli	5	0	2
Miscellaneous	7	0	1

The site of the thoracotomy must vary with the particular case. Operation should be preceded by careful *x*-ray studies to determine the location and extent of the pus. The site should be determined with a view of giving dependent drainage, but should not be at the extreme lowest part of the cavity lest it be shut off as the cavity narrows. When possible also the site should be such that the patient does not lie on the drainage tube, as this becomes very uncomfortable. In large collections which fill much of the pleural sac a site in the posterior axillary line at about the eighth interspace is favorable both in horizontal and upright positions of the patient. Some of the more unusual locations may be difficult to reach. This is especially true of those in the upper chest in front or back. These may be approached through the pectorals or high in the axilla. Small collections beneath the scapula and at the lower inner angle at the junction of the diaphragm and mediastinum are the hardest. It is a wise precaution in every thoracotomy first to insert an aspirating needle and when the pus is located do the thoracotomy with the needle in situ.

The question of irrigation of the empyema cavity with antiseptic fluids has received much attention. During and after the War Dakin's solution was much used. It has the advantage of liquefying fibrin clots and dissolving exudate, but the technique of preparing the solution is so complicated, and as it must be absolutely correct and absolutely fresh to be of any use at all, its usefulness is greatly restricted. A solution of sodium citrate will aid in dissolving the fibrin clots if needed but they will usually break down of themselves in time.

A 1:1000 solution of acriflavine for irrigation was much used in England and Canada and somewhat in this country in an effort to sterilize the cavity. It is much easier to prepare and use than Dakin's solution and in many cases the cavity can be sterilized so that it can be closed. However with either solution, if there is an error in judgment and the cavity is closed before it is entirely sterilized it has to be reopened again and much time has been lost. We now do not try for closure but do sometimes use a mild antiseptic solution like acriflavine to wash out the cavity when the drainage seems to persist in large amounts and especially when it is irritating in nature and fever persists. Of course irrigations should never be used in the presence of a bronchial fistula.

A bronchial fistula is a serious complication and if the communication with the bronchus is large, these cases are apt to have a chronic sinus which requires radical

operation to cure. There is no space to go into that subject in this paper. A bronchial fistula means that there was originally a deep abscess of the lung which opened both into a bronchus and also into the pleural cavity.

As stated earlier in this paper, one should not be bound to the method of simple thoracotomy but should consider it simply as an initial procedure which may be sufficient. If the condition does not progress steadily to a cure and there is the slightest indication that drainage is not adequate, there should be no hesitation in doing a secondary rib resection, with thorough exploration of the cavity with the finger. Sometimes accessory cavities will be found (and the *x*-ray is a help in this) which are communicating with the main cavity through such a small opening that they empty themselves only when the pus is under pressure and consequently have no opportunity of collapsing.

There have in the last three years appeared papers from at least two sources (Roeder[4] of St. Louis and Connors[5] of New York) advocating a very radical treatment of acute suppurative pleurisy. This consists in the resection of several inches of one or two ribs, and the thorough exploration of the infected pleura and lung and then packing the empyema cavity tightly with iodoform gauze. This gauze is changed daily and repacked more loosely so that the lung can gradually expand.

It is claimed for the method that it permits a full study of the infected area, and that the packing tends to rupture any further cortical abscesses of the lung and helps remove fibrin and exudate.

Against it are the unnecessary severity of the operation in a debilitated subject, the pain and shock which accompany the dressings.

Treatment along these lines is often needed in the cases of chronic empyema but we believe should be reserved for them. By chronic empyema we usually mean cases that after operation or operations have persisted in maintaining a discharging sinus, or have showed recurring collections of pus. There will be a small proportion of these in any series and the causes are usually either:

(1) The partial blocking off of some portion of the infected pleural cavity as the lung expands, so that it does not drain adequately

(2) The presence of an unhealed lung abscess which is continually or intermittently feeding infection into the pleural sac

(3) The presence of a bronchial fistula

(4) An osteomyelitis of the rib from infection or pressure necrosis. The treatment of chronic empyema is entirely individual in each case and could not be entirely covered even in a paper devoted to that subject alone.

Our feeling as to the best method of handling patients with acute suppurative pleurisy is to study and treat each case as seems best for that particular patient, no stereotyped course being followed; to protect the patient in every way by conservatism; and we believe that the simplest methods of procedure are usually the best. We feel that our results justify us in these conclusions.

MORTALITY

Of our total of 207 cases there were 22 deaths, a percentage of 10.6. If we exclude Group 3, those in which empyema was merely an incident in the general sepsis and which cannot properly be called empyema deaths, there were 194 cases with 14 deaths, a rate of only 7.2 per cent. In children under fourteen years of age, who furnish a large share of the mortality in most series, our rate was 5.1 per cent.

The nearest approach to this low rate that I have seen in a very imperfect search of the voluminous literature is in a report by Cohen[6] from the Lebanon Hospital in New York, giving a total mortality in babies under one year as 30.7 per cent, and in the second year 16.6 per cent, whereas our series gives no deaths in the 16 babies under one year and 2 deaths between one

and two years, or 9.5 per cent. The latest report is given in a recent article by Dr. Evarts Graham[7] of St. Louis from the Children's Hospital, of 116 cases in children with a mortality of 11.2 per cent, with 36 patients under two years with a mortality of 22 per cent.

We feel that one important factor in producing these results in young children is the fact that they are kept on the pediatric service with the surgeon supervising only the surgical procedures. In this way they get better medical and feeding care than would be likely on the surgical division. In the same way sick adults are often kept on the medical service.

TABLE V
CONDITION ON DISCHARGE

	Group 1	*Group 2*	*Group 3*
Cured	35	2	1
Improved	139	3	4
Died	14	0	8

The improved cases were mostly nearly healed on discharge.

CONCLUSION

In conclusion, we believe that this report proves our theory that no complicated method of treatment is needed in suppurative pleurisy, but the application of the most ordinary surgical procedures if combined with the few principles given, will result in a cure in the majority of cases. Briefly these principles are:

1. Safeguard in every way the patient's strength.
2. Do not operate in the presence of active pneumonia.
3. Do the least possible at the initial operation.
4. Use local anesthesia.
5. Never permit rapid escape of large amounts of pus.
6. Two or more simple operations are much better than one radical one.
7. Keep in close cooperation with the pediatrician in cases of children, for nutritional care.
8. Consider each case individually and have no routine method.

REFERENCES

1. HOLT and HOWLAND. Diseases of Infancy and Childhood. Ed. 9, page 445.
2. GIBSON, C. L. Valvular thoracotomy for empyema. AM. J. SURG., n.s. 6: 625, 1929.
3. LILIENTHAL, H. New York. Personal communication.
4. ROEDER, A. A. The gauze pack in treatment of empyema of the pleural cavity. AM. J. SURG., n.s. 8: 611, 1930.
5. CONNORS, J. F. The treatment of lung abscesses and empyema by packing. *Ann. Surg.*, 94: 38, 1931.
6. COHEN, M. Acute suppurative pleurisy in children. *Surg. Gynec. Obst.*, 54: 696, 1932.
7. GRAHAM, E. A. Treatment of acute empyema. *Ann. Surg.*, 98: 520, 1933.

PERINEPHRITIS AND PERINEPHRITIC ABSCESS*

HENRY G. BUGBEE, M.D.

NEW YORK CITY

DUE largely to refinements in urological diagnosis, attention has, during recent years, been more closely focused upon the kidneys. The result has been an earlier recognition of renal pathology, a better understanding of the various lesions encountered in the kidneys, and a more prompt institution of therapeutic measures directed toward their elimination.

This applies to kidney infections from the standpoint of the mode of transmission of infection to the kidney, localization of infectious processes in the kidney, whether confined largely to the cortex, medulla, or pelvis; also to the relationship between perirenal infections and those of the kidney itself.

That the vast majority of kidney infections are hematogenous in origin is now generally accepted. Recent studies have concentrated not alone upon the more common types, such as pyelonephritis and its more advanced forms, but also upon rarer types of infections such as septic infarcts and carbuncle of the kidney.

These investigations have aroused a renewed interest in the perinephrium and its involvement in septic processes, numerous contributions featuring analyses of various series of cases, with attempts to arrive at some definite classification of such infections from an etiologic and pathologic standpoint, being found in the urological literature, especially of the past few years.

In any discussion of perirenal infections one should recognize the perinephrium as a separate structure with its own blood and lymphatic supply.

The anatomy of the perinephrium has been well described by Zukerkandl[1] and Gerota,[2] and was reviewed in detail by Miller in 1910. These investigators showed the perinephrium to consist of a definite layer of fat which is paler than the fat of the mesentery, is absent at birth, but becomes fully developed in adult life and is enclosed within the renal fascia. This layer of fascia has been described in detail by Gerota,[3] and is often alluded to as Gerota's fascia. It is due to the presence of this fascia that suppurative processes arising in the perinephrium, or rupturing into the perinephritic space from the kidney, remain localized for such a long period of time; also that retroperitoneal suppurations frequently gravitate to eventually surround the kidney.

The blood supply of the perinephrium is derived from a small branch given off of the renal artery at or before its bifurcation, a branch of the first lumbar, and occasionally branches from the spermatic or ovarian, the suprarenal or mesenteric; also intercolumnar arteries of the renal cortex, which after penetrating the kidney capsule terminate in the perinephrium.

The lymphatic supply of the perinephrium and kidney, also summarized by Miller,[4] is described as consisting of three sets of lymphatics, the first, draining the cortex and medulla of the kidney, emerging at the hilum and joining the lateral lumbar lymphatic group; the second, a set of vessels which lies beneath the fibrous capsule of the kidney and joins the first set; and the third, a set of vessels beneath the peritoneum, in the perinephrium, ending in the upper lateral lumbar nodes, as well as communicating with the subcapsular kidney group.

From this close relationship of the perinephrium to the kidney, both from its

* Read at the New York Academy of Medicine before the combined Sections of Medicine and Urology.

anatomical position as well as through its blood and lymphatic supply, the difficulty may at once be appreciated, of differentiating infections of the perinephrium from those of the kidney, also of determining the source of infections of the perinephrium.

That infection of the perinephrium takes place by direct extension of a suppurative process in the renal cortex, either by the rupture of such a process through the renal capsule, or by transmission through lymphatic or capillary channels, is well recognized, having been frequently proved clinically and at operation; in fact, recent observers have in some instances taken such a positive position as to assert that all perinephritic suppurations are secondary to similar lesions in the renal cortex.

This position does not seem altogether justified from the standpoint of clinical observations, operative or necropsy findings, from which sufficient evidence has been obtained to warrant the assertion that metastatic infectious processes do arise in the perinephrium independent of renal involvement, such cases being analogous to those of acute hematogenous osteomyelitis.

The first group of cases, i.e., those secondary to some local suppurative lesion, has been variously classed as perinephritic abscess, secondary perinephritic abscess, perirenal or perinephric abscess; while the metastatic abscess has been termed primary perinephritic abscess, or extrarenal. If the latter term (extrarenal) is employed, it would include not alone metastatic abscesses of staphylococcus origin, but perivesical and pelvic infections which have gravitated upward, being limited by Gerota's fascia, while these latter cases are not, strictly speaking, perinephritic, but perirenal.

In a recent communication, Vermooten[5] emphasized this point and suggested that metastatic suppurative lesions of the perinephrium be designated as perinephritic abscess; while a suppurative process in the perinephrium arising from an extension from within the kidney or from elsewhere, be termed perirenal or perinephric. This, it seems to me, is a logical and descriptive terminology, and differentiates the two types of infection, both from the etiologic and therapeutic standpoints, simple drainage offering a cure for metastatic or perinephritic abscess; while drainage may be only a preliminary step in the perirenal type, the elimination of the primary focus being necessary, either at the time of or secondarily to the drainage.

Metastatic suppurations of the perinephrium, i.e., perinephritic abscesses, are as a rule due to the staphylococcus and are most often secondary to superficial infections such as boils, carbuncles, and infected wounds. The property possessed by the staphylococcus to clump and form septic emboli in the terminal arterioles of the perinephrium probably has a direct bearing upon its incidence.

Perirenal or perinephric abscess results from a direct extension to the perinephrium of a renal focus, such as a pyelonephritis, pyonephrosis, septic renal embolus, renal carbuncle, or cortical renal abscess, in which connection renal tuberculosis, calculus, renal cysts and trauma may bear an important etiological rôle; or it may be an abscess arising outside of the urinary tract which has gravitated to surround the kidney. Perinephric infections likewise may be due to the staphylococcus, especially when secondary to cortical renal foci; the colon bacillus, however, is more often the causative agent, while, in other instances, there is a mixed infection.

A recent study by Rolnick[6] emphasizes the possibility of the extension of infection along the peri-ureteral sheath. Injections of an opaque medium were made into the ureteral sheath in postmortem specimens, these injections being made at the juxtavesical portion of the ureter, also at the renal pelvis, subsequent *x*-rays revealing the ease with which the fluid could be forced up or down along the sheath of the ureter. Injections into the fascia at the base of the bladder near the ureter, or the sheath of the seminal vesicle, also

into the loose tissue at the base of the bladder in the female, were followed by a similar dissemination of the fluid. From these observations, Rolnick concluded that bands and adhesions about the ureter and renal pelvis, periureteritis, peripyelitis, and perinephritis acute and chronic, and of varying degrees of severity, including perinephric abscess, may result from an extension of infection along the sheath of the ureter, secondary to pelvic infections in both sexes.

In one of five cases of perinephritic abscess reported by the writer[7] following overwhelming influenza infections during the epidemic of 1918, a prostatic and perinephritic abscess occurred in the same individual. As to whether the second abscess was due to an extension of the infection along the sheath of the ureter, or whether both were simultaneous hematogenous infections one could not say.

In reviewing the cases of perinephritic suppuration at St. Luke's Hospital for the past fifteen years, 41 cases are recorded, 10 in females, and 31 in males, to which the writer has added 11 cases not included in this list: 3 females and 8 males, for a total of 52 cases, 13 females and 39 males; (this disproportion in the incidence in the sexes corresponds with other clinical reports).[8]

These cases have presented a variety of clinical pictures, and may be divided into: (1) Those cases having the characteristics of metastatic abscesses of the perinephrium, secondary to infections in other parts of the body, especially superficial foci, as boils, carbuncles, and infected wounds; but also to tonsillar, teeth, and sinus infections; (2) those cases in which a definite focus of infection in the kidney had extended to the perinephrium, and (3) perirenal abscesses which, although primarily extraneous suppurative processes, had become localized in that position because of the confines of the renal fascia; as, for instance, an appendicular or pelvic abscess which had gravitated upward to surround the kidney.

In 29 of these 52 cases, no evidence of kidney infection could be demonstrated by cystoscopic or *x*-ray findings. These cases belong to the first group, i.e., that of metastatic or primary perinephritic abscesses. The following foci of infection were present in other parts of the body: superficial boils, carbuncles and infected wounds 9; influenza 5; teeth 3; gall bladder 2; sinuses 2; tonsils 1; Vincent's angina 1. Of the remaining 6 cases of this group, the symptoms had been present for from two weeks to two years. The Staphylococcus aureus or albus (the former in 11) was present in 14 cultures taken from the pus evacuated at the time of incising the abscess. One patient of this group died, necropsy showing a splenic tumor, no primary focus of infection and no kidney infection being demonstrated.

There were 16 cases of the second group, in which definite renal foci could be demonstrated through cystoscopic findings, *x*-rays, or at operation, the perinephric abscess apparently being an extension of the renal lesions which were as follows: calculi with infection 4; pyelonephritis 3; cortical abscess 3; ruptured kidney 2; tuberculosis 2; pyonephrosis 1; polycystic kidney 1. In 6 of these cases the colon bacillus was present on culture; in 3, a mixed staphylococcus and colon bacillus, and B. pyocyaneus in 1.

In 4 cases of the third group of perirenal abscesses, 2 followed two and four weeks after operations for a prostatic abscess, a third one month after an appendicular abscess, and the fourth after an operation for hernia. In another case of this group, there was a carcinoma of the colon, and in 2 others, no source of the abscess could be ascertained at operation. Two patients of this group died, one showing at autopsy a bilateral pyonephrosis, and the second an empyema, the perirenal abscess having ruptured into the pleural cavity.

As cortical renal lesions often present no urinary symptoms, also negative urine, cystoscopic findings, pyelograms, and *x*-rays, and as the kidney is seldom explored

carefully at operation for the drainage of a perinephritic abscess, it would be impossible to rule out the kidney as a primary source of infection in all cases of so-called primary or metastatic perinephritic abscess. In a review of 106 cases of perinephritic suppuration at the Mayo Clinic, Hunt[9] reported 47 as proved to be secondary to primary kidney lesions. With definite extra-urinary foci in 21 of the 29 cases of this group, no renal foci which could be diagnosed prior to, or discovered on superficial examination of the kidney at the time of operation, and the absence of a renal lesion in the one case of this group that came to autopsy; also considering the prompt recovery which took place in all but one case of this group, following simple drainage, one must conclude that there is a group of cases which are, in all probability, independent of renal pathology and are metastatic in origin.

Possibly the most interesting feature of perinephritic suppuration is the question of diagnosis. The onset may be sudden and characterized by a definite train of symptoms; or weeks, or months may elapse before the clinical picture becomes clarified.

With a history of boils or some other superficial infection, a sudden onset of pain in the costovertebral angle, fever, chills, a leucocytosis and local tenderness, the diagnosis may not be difficult. If, however, as in many of these cases, indefinite symptoms may have been present for weeks, months, and even years (in one case five years); general malaise and irregular fever being, possibly, the only symptoms present; the making of a diagnosis of perinephritic suppuration may tax the skill of the clinician to the utmost. With the frequent absence of urinary symptoms (in Swan's[10] series of 114 cases reported from the Massachusetts General Hospital they were present in less than one-third), the presence of a negative urine, negative *x*-ray findings and cystoscopic data, including renal functional tests, there is often little evidence to lead one to focus upon the urinary tract.

In this series of 52 cases reviewed by the writer, 43 patients complained of more or less definite pain in one or the other lumbar region. In the majority, the pain was localized in the costovertebral angle; in other instances, however, it extended over one side of the back; and again was general, over the entire back. Radiation to the hip and thigh was noted in 4 cases, and exaggerated by flexing the thigh. Radiation to the chest was noted in 2 other cases. The pain in the cases of long standing was often classed as lumbago, while in the more acute cases it was frequently very severe. In general, one may say that if the abscess is posterior, the pain will be lumbar and radiate to the inguinal or hypogastric regions or the tip of the twelfth rib; if superior, the abscess simulates an empyema; and if inferior, the pain will be confused with that accompanying cholecystitis or appendicitis.

The temperature showed similar variations, in the more acute cases rising to 105°, being continually high in some instances, intermittent in others; while, in the more chronic types, elevations of temperature were often absent, and in several the temperature was subnormal. Periods of exacerbation with profuse sweats were noted, and in certain instances the temperature dropped as the local symptoms subsided, which was due to a release of tension in the abscess caused by its rupture through the renal fascia.

In all of the cases of acute suppuration, a leucocytosis was present and maintained until drainage was established; while the blood count often showed little change in the more chronic cases. The presence of a leucocytosis was important in differentiating perinephritic abscess from typhoid fever. Anemia was often pronounced (in a recent series of 44 cases reported by Habein[11] from the Mayo Clinic, the hemoglobin showed an average of 53 per cent).

Local tenderness, most often in the costovertebral angle, was the most common physical sign in this series of cases, being

often acute, and, as a rule, continually present. In 4 cases, the tenderness was more pronounced anteriorly, and was accompanied by abdominal rigidity. A tender mass could be palpated in the kidney region in 14, and a swelling at the outer border of the erector spinae muscle was noted in 16. This mass was fluctuating in 5. Aspiration (a procedure not often advisable, because of the possibility of carrying infection into the kidney) was attempted in 8, and pus obtained in 5. Extension of the abscess may take place upward to raise the diaphragm, posteriorly and laterally to give rise to a tumor mass evident to the eye, downward on the psoas muscle behind the peritoneum, pointing above or below Poupart's ligament, forward into the peritoneal cavity, or, rarely into the blood stream.

A curvature of the spine away from the affected side was noted with the patient in the sitting position in 12 instances, and in 8, this curvature was demonstrated in the *x*-rays. This deformity is apparently due to a spasm of the muscles in the vicinity of the suppurative process, and has been noted by various observers.[12,13,14]

Obscuration in *x*-ray films of the outline of the psoas muscle by the overlying abscess was noted in 11 cases. Likewise, the contour of the kidney shadow was often indefinite or completely lost, or hidden by dilated coils of the bowel. Anterior displacement of the ureter by the abscess was also demonstrated in stereoscopic films.[15]

It may be seen from the foregoing that in an occasional case of perinephritic or of perinephric abscess the clinical picture is characteristic; while, in the majority of instances, the signs and symptoms are decidedly misleading, often rendering a differential diagnosis extremely difficult. A variety of gastrointestinal symptoms (nausea, vomiting, flatulence, constipation and diarrhea), also chest symptoms, were frequently noted. General malaise, loss of weight, intermittent pain, fever, and sweats were the common symptoms in the more chronic cases, which symptoms could readily be confused with a great variety of chest, abdominal, and bone diseases, including empyema, pleurisy, subphrenic abscess, gall-bladder disease, various intraperitoneal lesions, caries of the spine, pelvic lesions in both male and female, hip-joint disease, and tuberculosis, as well as a variety of pathological conditions in the kidney itself.

A differential diagnosis between renal pathology and perinephritic suppuration is often impossible. Lesions limited to the renal cortex, as already stated, often give rise to no urinary symptoms, may reveal no cystoscopic data, and, even at operation, especially in the case of a large perinephritic abscess of long standing, one may be unable to eliminate the kidney as the source of the infection of the perinephrium, or as a co-existing focus. With our knowledge of renal infections, their hematogenous origin in most instances, and the free lymphatic and circulatory communication between kidney and perinephrium, the possibility of the existence of a small cortical lesion which may easily be overlooked at operation must always be borne in mind.

In one case of the writer's, 3 quarts of pus were evacuated from a perinephritic abscess, yet the kidney showed normal function, and there was an absence of demonstrable signs of renal infection prior and subsequent to operation. However, in 2 instances, I was able to insert my finger into a cortical renal abscess, and in another case into a renal cyst cavity, at the time of operation for the drainage of perinephric abscesses. In all 3 cases, the kidney lesion healed satisfactorily without further operation, demonstrating the impossibility of stating in how many instances cortical lesions of small size may be present, drain into the perinephrium, and heal after the perinephritic abscess is drained. On the other hand, one child with a persistent temperature ranging from 104 to 106°, a negative urine, and with marked costovertebral

tenderness, showed at operation no involvement of the perinephrium, but multiple, small, discrete abscesses of the renal cortex. These abscesses were drained, the patient making a prompt recovery.

A series of similar cases in children has been reported by Eisenstadt[16] and termed paranephric abscesses. He called attention to the complex nature of the diagnosis, emphasizing intense prostration, high fever, sweats, restlessness, and indefinite character of the pain as especially suggestive of this condition.

The possibility of perinephritic suppuration should never be lost sight of in studying any case of prolonged illness (in one series of 60 cases reported by Teposu,[17] 64 per cent of the cases were transferred from the medical service of the hospital), every means of clinical observation and investigation, including *x*-rays and cystoscopic studies, should be carried out, that a diagnosis may be made before the system has become undermined by a prolonged sepsis.

In one of my cases, a single cystic kidney (the other kidney having been removed elsewhere for calculi four years previously), symptoms had been present for two years. Cystoscopic data were confusing, but clinical observations suggested a perinephritic abscess. The abscess communicated with a cortical cyst; both the abscess and the cyst were drained under local anesthesia, and the patient has since been well.

A male, forty-four years of age, was operated on elsewhere six years previously, a perinephritic abscess being drained. With his back muscles strongly developed, and a negative physical examination, it was difficult to explain his gradual decline in health and strength. Because of indefinite pain in the back, he was referred to me as possibly suffering from a prostatic lesion. The prostate was congested, but no other pathology was discovered in the urinary tract. However, continued backache, the subsequent development of local tenderness and a persistent temperature, led to an exploration of the kidney region which revealed several large pockets of pus between the layers of the muscles of the back, as well as an abscess in the renal cortex. Drainage of the abscesses and subsequent nephrectomy resulted in a cure.

An early diagnosis, followed by drainage of the abscess, if perinephritic, will result in a cure; and one should not wait too long for manifest symptoms of suppuration; while, in cases of perinephric abscess, not only drainage of the abscess, but an immediate nephrectomy if the condition of the patient warrants, or secondary nephrectomy, may be necessary to establish a cure. If associated with the presence of a renal calculus, the question of the removal of the calculus at the time of drainage of the abscess, or subsequently, must be taken into consideration. The same is true of cases of traumatic rupture of the kidney, also of those cases in which an extensive destruction of the kidney has resulted from infection.

That certain patients with perinephritic suppuration recover without operation there can be no doubt; the possibility, however, of a perirenal sclerosis which may give rise to persistent pain and result in a lowered kidney function, must be borne in mind. O'Conor[18] has reported two such cases, and Schwartz,[19] others, in all of which recovery followed decapsulation. In doing a nephrectomy in cases in which the kidney has been the seat of long-standing infection, an absence of the perinephric fat has been repeatedly noted; also that the kidney has frequently been bound down by very firm adhesions which have indicated an extension of renal infection to the perinephrium, a healing of the suppurative process, and a resulting sclerosis.

The possibility of bilateral perinephritic abscess must be considered, and suspected in those cases in which the physical signs and symptoms do not clear up readily after unilateral drainage, and in which pain and tenderness develop on the opposite side. Two cases of this series presented an involvement of the opposite side; in one, two weeks, and in the second,

eighteen days after drainage of the original perinephritic abscess. Both required a drainage of the second abscess.

From the review of these cases, as well as of the recent literature upon the subject, it seems to me that from the general medical as well as the urological viewpoint, we should look upon perinephritic suppuration as a clinical entity which must be constantly borne in mind, especially in all cases of prolonged sepsis.

SUMMARY

In summarizing, I should like to emphasize the following points:

1. That the perinephrium, while closely associated with the kidney, should be recognized as a separate structure, with its own blood and lymphatic supply, and enclosed in a firm layer of fascia.

2. Suppurative lesions of the perinephrium may be classed as (a) metastatic or perinephritic abscess, most often due to the staphylococcus and secondary to septic foci present elsewhere in the body, and (b) perinephric abscess, which is either secondary to a cortical renal focus of infection, or is an abscess which surrounds the kidney, being confined within Gerota's fascia, but has originated outside of the perinephrium or kidney.

3. It is often impossible to differentiate cortical renal lesions from suppuration in the perinephrium, and not infrequently the two are associated.

4. The symptoms of perinephritic abscess may be clear-cut and the diagnosis not difficult; or they may be extremely vague, —unexplained fever and general malaise possibly being the only manifestations of the disease.

5. Urinary symptoms and cystoscopic data are negative in a large proportion of cases of perinephritic suppuration, also in cortical renal lesions. They may be present only when there is an extensive involvement of the kidney. *X*-ray findings are often negative, but, if positive, are of distinct value in establishing a diagnosis.

6. Perinephritic abscess should be suspected in all cases of prolonged wasting illness accompanied by an unexplained fever, as well as in those cases presenting a more or less clear-cut picture; every effort should be made to establish an early diagnosis, and drainage should be instituted promptly, without always waiting for manifest signs of suppuration.

7. In perinephric abscess, not only should the abscess be drained, but the elimination of the original focus of infection may necessitate either a primary or a secondary nephrectomy.

REFERENCES

1. Zukerkandl. *Med. Jabrb.*, pp. 59–67, 1883.
2. Zukerkandl and Gerota. Quoted from Miller.[4]
3. Gerota. *Arcb. f. Anat. u. Pbysiol.*, pp. 265–285, 1895.
4. Miller, M. B. *Ann. Surg.* 51: 382–415 (Mar.) 1910.
5. Vermooten, V. *J. Urol.*, 30: 181–193 (Aug.) 1933.
6. Rolnick, H. C. *Arcb. Surg.*, 26: 41–49 (Jan.) 1933.
7. Bugbee, H. G. *J. A. M. A.*, 73: 1053–1056 (Oct. 4) 1919.
8. Wittpoth. *Tberapie d. Gegenwart*, 26: 542–545 (Dec.) 1924.
9. Hunt, V. C. *J. A. M. A.*, 83: 2070–2074 (Dec. 27) 1924.
10. Swan, C. S. *New England J. M.*, 209: 180–184 (July 27) 1933.
11. Habein, H. C. *Minnesota Med.*, 11: 292–296 (May) 1928.
12. Carty, J. R. *Boston M. & S. J.*, 195: 654–657 (Sept. 30) 1926.
13. Revesz. *Ztscbr. f. urol. Cbir.*, 18: 333–334, 1925.
14. Beer, E. *J. A. M. A.*, 90: 1375–1376 (Apr. 28) 1928.
15. Peacock, A. H. *Surg. Gynec. Obst.*, 48: 757–765 (June) 1929.
16. Eisenstaedt, J. S. *J. A. M. A.*, 92: 48 (Jan. 5) 1929.
17. Teposu, E. *J. d'Urol.*, 34: 231–232 (Sept.) 1932.
18. O'Conor, V. J. *J. A. M. A.*, 85: 1118–1120 (Oct. 10) 1925.
19. Schwarz, O. A. *Ztscbr. f. urol Cbir.*, 26: 38–51 (Jan.) 1929.

PERINEPHRITIC ABSCESS

REPORT OF CASES

ARTHUR M. DICKINSON, M.D., F.A.C.S.

ALBANY, N. Y.

ABSCESSES of the perinephritic area are exceedingly interesting. They carry with them a mortality rate that is much too high for the credit of modern surgery and offer ample field for speculation as to their causes. They frequently tax the diagnostic ability of the family physician, the surgeon, the urologist, the gynecologist and the radiologist. The condition is one of antiquity for Hippocrates recognized it in 460 B.C. and advised early drainage.

The perinephritic area is generally accepted to mean that area located behind the posterior peritoneum in the region of the kidney; its limits are not sharply defined. The space is bounded above by the diaphragm, mesially is the vertebral column, laterally is the abdominal wall and posteriorly are the psoas muscle and fascia. Below, this area is contiguous with the retroperitoneal areas of the false and true pelvis; so infection arising in one area may easily spread to the other. The area about the kidney contains considerable fatty and areolar tissue; this perirenal fat is nourished by end-arteries, thus making it more susceptible to blood-borne infection. About the kidney is a fascial sheath, closed above but open below. This perinephritic area has none of the natural barriers which limit the spread of infection in other parts of the body.

The urologists divide perinephritic infections into two great groups: one in which the infection is the result of direct extension from the kidney and a second group in which the infection results from the blood or lymphatic streams. Much has been written in attempts to prove which was the more common mode of infection; numerous case reports are cited but so far no agreement has been reached. In Germany, the term perinephritis is used to indicate an inflammatory process limited to the kidney capsule while the term paranephritis is used to designate those infections involving the perirenal fat. Mathe[1] in a very comprehensive article divides perinephritis into non-suppurative and suppurative groups; these are subdivided into primary and secondary groups. Under primary suppurative perinephritis, he includes those infections of hematogenous, toxic or traumatic origin; in the secondary group he places infections arising from extraneous lesions in the kidney, suprarenal gland, intestinal tract, abdominal and pelvic viscera, prostate, muscles of the vicinity, lungs, pleura, skin, etc.

Perhaps a clearer conception of perinephritic abscesses would be gained if we divided these infections into two groups. The first group would consist of those cases in which the infection arose by direct extension from the kidney or was borne to the perinephritic area by lymph or blood streams; the infection would first involve the perirenal tissues and would be known as a perinephritic abscess. In group two would be placed all of those cases in which the only relationship to the kidney was one of proximity; this would include cases arising through infection by blood and lymph channels and by direct extension from neighboring organs; this group would be known as paranephritic abscesses.

Whatever classification of these cases may be adopted and whatever the etiology may be, all authors agree that perinephritic infection is a serious condition which too

often escapes detection until the patient is moribund. For example Braasch[2] says, "I know of no condition in the field of urology which can be more difficult to diagnose." Rigler and Manson[3] have presented a very interesting study of a group of these cases citing mortality rates from the literature varying from 6 to 40 per cent. They emphasize strongly the fact that delay in diagnosis is responsible for the high mortality rate and quote figures from the Mayo Clinic showing that the average time elapsed from the onset of symptoms to the establishment of correct treatment was thirty-eight days.

ETIOLOGY

Age is apparently a factor in the occurrence of these abscesses, especially as the causal factor itself is influenced by it. No time of life is exempt but the condition is more common between the ages of twenty and forty. Males are more commonly affected than females, the ratio varying in different series from 5 to 1, to 4 to 3. It is claimed by certain writers that the primary source of infection is always to be found in the kidney but careful study of a series of cases does not confirm this. For instance, Peacock[4] reports 21 cases of perinephritic abscess. In 9 of these, the source of infection was proved to be kidney; in 5 others, the source was extrarenal such as appendiceal infection, boils, tonsillitis, etc.; in the remaining 7 cases the source was questionable. Obviously, infection of the perinephritic space may arise by transmission through the blood stream, through the lymphatics or by direct extension. Extension through the blood stream seems so real to Brunn and Rhodes[5] that they liken a perinephritic abscess to an osteomyelitis in children. This opinion is further borne out by the finding of positive blood cultures in these cases so frequently. Lymphatic extension from the kidney itself or from neighboring organs appears quite commonly as the mode of infection. Direct extension by contiguity of tissues frequently seems to be the etiologic factor. That the primary focus is not always obvious is emphasized by Campbell;[6] he reports a series of 83 cases in which the primary focus was determined in only one-half. In some instances injury may be a factor, perhaps by localizing infection or lighting it up; this point is illustrated in Case 1 reported below. That the factor of direct extension of infection is of more importance than the literature would seem to indicate, appears probable. We know that the retroperitoneal tissues possess but slight resistance to infection. So infection arising in a retrocecal appendix may easily spread to the perinephritic area. The tip of the appendix itself may be retroperitoneal and so convey the infection or the infection may ulcerate through the posterior peritoneum. In two of the cases reported below, the proved source of infection was the appendix and in the third, the appendix was suspected strongly. In a similar manner, ulcerations of the bowel or of diverticula may result in retroperitoneal infection; especially is this

Fig. 1. Radiograph from Case 1. Normal pyelogram. Gas in tissues outside of intestinal tract. Thickening of lateral abdominal wall.

true of the duodenum where it lies behind the peritoneum. Occasionally a ruptured gall bladder or a perforated peptic ulcer

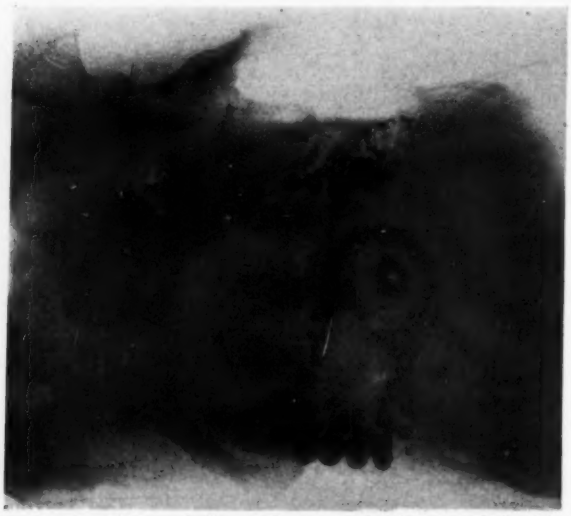


FIG. 2. Radiograph from Case III. Patient on left side; note gas and fluid level in contrast to barium in intestinal tract.

may be the source of infection. In the female, pelvic infection may also be a cause. Various organisms are found in these perinephritic abscesses; the colon bacillus and the staphylococcus are most common but sometimes streptococci, gonococci, pneumococci or other bacteria are isolated.

PATHOLOGY

Perinephritic abscesses vary greatly in size depending upon their duration and the nature of the infection. The overlying tissues may show some redness and edema. In some instances the abscess cavity will contain a small amount of pus while in others there will be a liter or more. Often the abscess cavity will contain a considerable amount of foul-smelling gas which is heard to escape when an incision is made into the cavity. Commonly the abscess cavities are trabeculated and finger-like pockets extend in various directions from the main cavity. In some instances, the primary source of infection such as kidney or appendix may be obvious. Perinephritic abscesses are usually unilateral and occur on the right side with twice the frequency of the left. Occasional instances of bilateral abscesses are reported; Campbell[6] cites two such instances and Taylor[7] one.

FIG. 3. Radiograph from Case III. Patient in upright position; note gas and fluid level.

SYMPTOMS

The symptoms of perinephritic abscess are too often indefinite. Frequently the condition is confused with typhoid fever, colitis, influenza or some other infectious process. Campbell[6] in his report of 83 cases at Bellevue Hospital, states that in 10 per cent of the cases, the symptoms strongly suggested some intraperitoneal condition. He remarks that two of these patients were subjected to an unnecessary appendectomy. In 33 per cent of these cases, the diagnosis was made at autopsy. The literature reports quite a few instances of unnecessary operations in these cases. In children the condition is frequently confused with tuberculosis of the hip. Kessler, Bennetts and Bacon[8] report a series of 81 suspected cases of perinephritic abscess in 3 of which the lesion was found in the adjacent bony structures.

The history of the onset of a perinephritic abscess is usually clouded or eclipsed by that of the primary condition. In some instances the primary condition has escaped attention entirely or has been considered of little importance by both patient and physician. This is illustrated in Case III, cited below. Usually however a careful investigation of the story of the patient will give a valuable clue. The significant fact seems to be that an illness, from which the patient thought he had recovered, returns or continues with the development of additional symptoms.

In the series of cases reported, fever appears to be the most constant and reliable symptom; it is usually remitting in character and accompanied by profuse perspiration. In some instances the fever may be so slight or irregular that it is not striking. Ordinarily the fever is preceded by chills. Pain is a more variable symptom. It usually is constant and of a dull type and does not radiate. Commonly it is located in the back, loin or kidney region. Tenderness is often marked. In some instances there is no complaint of pain at all. Quite often the gastrointestinal symptoms are so marked that attention is focussed upon these organs; nausea, vomiting and constipation are common. There may be distention of the abdomen. Urinary tract symptoms are present in only about 10 per cent of the reported cases.

One thing about all of these patients is that they impress you as being ill; they look toxic; they have lost weight and are dehydrated.

In neglected cases there may be edema or redness of the overlying tissues but this is a late symptom as it takes a long time for infection to extend through the lateral abdominal wall. If there is an accumulation of gas within the abscess cavity in addition to pus, one may get tympany upon percussion along with a definite succussion sound; this combination of physical signs is at first difficult to interpret, especially when found in an area where the percussion note is commonly flat. In Case III, reported below, these findings led to a preliminary diagnosis of lumbar hernia. Some generalized enlargement of the one side may be noted but no localized swelling appears until late in the course of the disease. This generalized enlargement is like a bulging and is often best observed when the patient stands or sits although it can be seen with the patient in the decubitus position.

Careful urological study will be of definite help in about 50 per cent of the cases according to Campbell.[6] Obviously where the infection is primary in the kidney itself, such studies will be of value but in those cases in which the kidney is not involved, little help is to be expected. In the latter group demonstration of displacement of the kidney or ureter by the inflammatory process may be suggestive.

Blood counts show the usual reaction to infection but in cases of long standing where the patient has little resistance, they may be of little value.

Radiography is frequently helpful; it will assist in the diagnosis in at least 50 per cent of the cases. The ordinary gastrointestinal series may demonstrate interference with normal function and suggest the primary condition. Frequently it is observed in these cases that the outline of the psoas muscle is obscured on the affected side; it is not uncommon to note a curvature of the spine away from the side of the abscess. A shifting fluid level may be demonstrated if there is sufficient fluid and gas. The finding of collections of gas in abnormal locations is also suspicious.

TREATMENT

Immediate treatment of perinephritic abscess consists of incision and drainage; the result is usually magical. In some instances, due to the serious condition of the patient, transfusion or administration of glucose and saline may be indicated before operation. At operation one should be sure to break up all trabeculae and explore all pockets so that thorough drainage is secured. No attempt as a rule should be made to treat the primary

condition at this time. Drainage should be prolonged until all infection has cleared up and dead spaces obliterated. Counter drainage is often wise. Careful closure of the incision is necessary for incisions in this area have a marked tendency to heal slowly and gape open. In a few months, after all infection has subsided, operative treatment should be directed toward the removal of the primary cause of the abscess.

CASE REPORTS

Case I. D. D., white, female, aged thirty-six, married with one child.

This patient was seen in consultation on February 11, 1927, complaining of pain in the right kidney region of three days' duration. At the age of twelve she had had an appendicular abscess drained through the right loin. For the past few years there had been some intestinal disturbance with flatulency and constipation, alternating with diarrhea. One week before she had been struck in the right loin by a driven golf ball; since then she had suffered with pain in this region accompanied by nausea and diarrhea.

The patient looked sick and in pain. The temperature was 102°F., pulse 106 and respirations 27. The heart and lungs were negative. In the right loin there was noted an oblique scar about 2 inches long; the scar was not red or tender and no swelling about it was noted. Posteriorly over the lower pole of the right kidney there was marked tenderness but no redness or swelling. The patient was admitted to the hospital for further study. During a three-day observation period, the temperature ranged from 100° to 103°F. and the pulse from 90 to 100. There was little change in the physical findings. The white blood count was 18,000; the routine urine examination was negative. X-ray showed some elevation of the right side of the diaphragm with apparent thickening of the tissues opposite the lower ribs on the right side; also there were noted collections of gas in the tissues outside of the ascending colon (see Fig. 1). Cystoscopic examination with right pyelogram was negative.

On February 14, an incision was made in the region of the old scar; about one liter of pus, blood and gas escaped; the appendix was not seen. The abscess cavity extended upward to the lower pole of the right kidney and downward behind the peritoneum into the pelvis. Cultures made at this time yielded the colon bacillus. Three weeks later the patient was discharged from the hospital but healing of the wound was delayed for several weeks.

At the time of discharge from the hospital the patient was advised to return later for appendectomy as the appendix was considered to be the primary focus. On April 1, 1928, she returned for this operation; in the interval which had elapsed since her previous admission she had remained perfectly well. At operation, on April 2, a long right rectus incision was made with mesial displacement of the muscle. The cecum was finally located high up on the right side of the abdomen and was involved in dense adhesions. By careful dissection the cecum was mobilized and the appendix found on the posterior surface; it consisted of a short stump of appendix buried in scar tissue. The appendix was amputated and the area inverted with a purse string. The patient made an uneventful recovery from this operation and was discharged on the fourteenth postoperative day with the wound dry and healed. Since then there has been no return of any of the former symptoms. Laboratory examination of the portion of appendix showed chronic inflammatory changes with much scar tissue in the walls.

Case II. M. B., white, female, aged thirty-nine, married with no children.

This patient was first seen at her home at the request of her family physician on May 19, 1932. She was complaining of generalized abdominal pain and distention with nausea and vomiting. Her previous history was negative except for constipation and indigestion of several years' duration. The present illness began two weeks before with severe pain in the stomach, formation of gas and vomiting. This continued for two days; then the patient felt better and was up and about although not entirely free of symptoms. Just when she thought she was going to get well, she experienced a chill, followed by fever. She then commenced to vomit several times a day and the abdominal pain increased. This continued with temporary remissions until I saw her.

Examination showed a rather sick-looking woman who was apparently in pain. Her temperature was 102°F., pulse 104 and respirations 30. The heart and lungs were negative. The abdomen was moderately distended and somewhat tender all over. Pelvic examination

was negative. That same day the patient entered the hospital where examination confirmed these findings. The white blood count was 23,480 with 79 per cent neutrophiles; the urine showed a trace of albumin with many pus cells. As the patient was badly dehydrated she was given intravenous glucose and saline and also saline under the breasts and by rectum; hot packs were applied to the abdomen and an enema given with a fair return. Under this treatment the patient's condition improved. On the day following definite tenderness was made out in the right flank but no swelling or edema was noted. Later in the day, incision was made in the right loin under nitrous oxide anesthesia and a large abscess filled with foul-smelling pus and gas was drained. Cultures from the abscess showed Streptococcus viridans. Following operation the patient made a rapid recovery and three weeks later was discharged from the hospital with the wound healed. The patient has been under observation since; her condition seems good but she complains of indigestion, gas and constipation. Abdominal operation with removal of the appendix has been advised.

Case III. J. N., male, aged fifty-two, married, two children.

He was first seen at his home in consultation on September 17, 1932 at which time he was complaining of a painless, transitory swelling of the right loin accompanied by loss of weight and strength. The patient stated that about five weeks before, he had suffered with a spell of indigestion, the only symptoms being belching of gas. After this had continued for four days, he consulted his physician who prescribed a diet and some medicine. There was no pain, no nausea or vomiting with this attack. At that time his physician examined the abdomen and found nothing abnormal. A few days later the indigestion disappeared but the patient remained weak. Later he observed a slight swelling of the right loin without any pain. During the past few months he had lost about 25 pounds which he attributed to inability to find work.

Examination showed a rather sick-looking and worried man; he was pale and thin. The temperature was 100° and the pulse 110. The general physical examination was negative except for the right loin. As the patient sat up in bed there was a definite bulging or swelling between the lower ribs and brim of the pelvis in the axillary line on the right side. This was not red or tender. On percussion posteriorly, there was a definite tympanitic note over an area about 10 cm. in diameter and on auscultation over this area, a tinkling sound was heard. Hospitalization was advised but refused. Two days later the patient was seen again. At that time the temperature was normal and the swelling less marked. Radiographs were then arranged for. The gastrointestinal series was essentially negative but there was observed a collection of gas external to the cecum which area none of the barium entered; lateral views showed a collection of gas posterior to the vertebral bodies. With the patient lying on his left side, a fluid level extending from the lower border of the ribs down into the pelvis was made out.

The patient was persuaded to enter the hospital on October 3. The admission temperature was 102.6°F. and the pulse 116. The weight was 98 pounds, the normal being 125. There was no essential difference in the physical findings from those previously recorded except for increase in pallor and weakness. At this time the erythrocytes numbered 2,800,000, the hemoglobin was 45 per cent (Sahli), the leucocytes 8400 with 69 per cent of polymorphonuclear cells. The urine was negative except for a few pus cells. The blood Wassermann was negative and the blood sugar and non-protein nitrogen values within normal limits.

The patient was prepared for operation by forcing fluids, administration of intravenous glucose (5 per cent) and securing a suitable blood donor. On October 5, under nitrous oxide anesthesia, a lumbar incision was made releasing a great quantity of foul-smelling gas and about one liter of pus. The abscess cavity extended upward to the kidney and downward into the pelvis with finger-like projections toward the midline. The cavity was drained with rubber drainage tubes. Recovery was prompt and the patient left the hospital thirteen days after operation with the wound healed. The patient was warned of the possibility of recurrence of the abscess and advised to return for abdominal exploration in four months. This advice was neglected and about six months following the original operation, the abscess reformed. Incision and drainage were again done with findings similar to those at the time of the original operation. Cultures made at this time yielded a member of the

B. proteus group. Recovery from this operation was prompt and the patient returned to his home in two weeks. Four weeks later the abscess refilled and opened spontaneously at home; the wound again healed rapidly. On June 5, abdominal exploration through a right rectus incision was made. The cecum was bound down by adhesions; the appendix was located behind the cecum. The proximal half of the appendix was not remarkable but the distal half was surrounded by adhesions with the tip buried in the psoas muscle. The usual appendectomy was done and the abdomen closed without drainage. Recovery was uneventful and the patient was discharged from the hospital on the fifteenth postoperative day with his wound dry and healed. The gross and microscopic examination of the appendix revealed nothing except chronic inflammatory changes. During the period which has elapsed since the final operation, the patient has been under observation; he is without complaints and is apparently as well and strong as ever.

CONCLUSIONS

1. Perinephritic abscess is discussed in detail.

2. A simple classification of these abscesses is suggested in which group 1, called perinephritic, consists of those cases in which the infection extends from the kidney or by way of blood or lymph channels to the perinephritic area, while group 2, called paranephritic, consists of those cases in which the only relationship to the kidney is one of proximity.

3. The difficulty of diagnosis is noted.

4. The value of radiographic studies is emphasized.

5. Three cases are reported in detail in which the appendix appeared to be the primary focus of infection.

REFERENCES

1. Mathe, C. P. Peri-nephritis-suppurative and non-suppurative. *Cal. & Western Med.*, 38: 149 (March) 1933.
2. Braasch, W. Peri-nephritic abscess. *Surg. Gynec. Obst.*, 21: 631, 1915.
3. Rigler, L. G., and Manson, M. H. Peri-nephritic abscess. Am. J. Surg., n.s. 13: 459 (Sept.) 1931.
4. Peacock, A. H. Perinephritic abscess. *Surg. Gynec. Obst.*, 48: 757 (June) 1929.
5. Brunn, H., and Rhodes, G. K. Acute hematogenous (metastatic) perinephritic abscess. *J. A. M. A.*, 94: 618 (March) 1930.
6. Campbell, M. F. Perinephritic abscess. *Surg. Gynec. Obst.*, 51: 674 (Nov.) 1930.
7. Taylor, J. A. Two unusual cases of perinephritic abscess. Am. J. Surg., n.s. 13: 11 (July) 1931.
8. Kessler, E. E., Bennetts, F. A., and Bacon, S. K. Perinephritic abscess. Am. J. Surg., n.s. 22: 223 (Nov.) 1933.

EARLY DIAGNOSIS OF CARCINOMA OF THE PORTIO UTERI*

WALTER SCHILLER, M.D.

VIENNA, AUSTRIA

IN former times cancer research was carried on by clinicians and pathologists as a side issue, but today in nearly all civilized countries it is served by its own institutions, and under these more favorable circumstances great and important results have been achieved in the last few years. Carrel's method of tissue culture has shed light on the biology of the cancer itself, and the procedure of protracted tar painting, which we owe to Yamagiva and Itchikawa, has helped to explain the mode of origin and development of a large and practically important group of carcinomas, the irritation carcinomas. In the morphologic field also the last few years have brought advancement, the cytologic findings on the cells of a wide variety of tumors may be especially mentioned. As valuable and important as the results of these researches are, they lie, nevertheless, almost wholly in the region of theory and have not had any useful application in the practical fighting of cancer.

All this work has yielded nothing for the practicing physician; it has had no influence on his activities, the treatment of cancer has not been affected. In the field of the practical fight against cancer recent years have been characterized by the development of operative and radiologic therapy, the only two methods of treatment which have been considered during this period. Progress in operative technique has consisted only in greater refinement of method, new paths have not been entered on. The second method also, radiotherapy of cancer, has been developed only in the sense that we have learned how to utilize more fully the present possibilities in roentgen and radium rays; nothing that is new in principle has come into use. It would seem that surgical technique has already reached the pinnacle of its development, and that it is hardly possible to go farther. Differences in results as between different surgeons are today ascribable not to differences in the operations used, but only to differences in the technique and skill of the individual operators, so that, aside from early diagnosis, which will be discussed presently, improvement in results must be sought in the training of the surgeon, not in improvement in operative methods. Roentgen and radium technique also has, to all appearance, reached an optimum, at least in the sense that with the rays that we now have at our disposal better results can hardly be obtained than the last few years have brought. Improvement of results in this field will depend on whether more effective radiations can be brought into use, a matter of the variety of the radiation and of the technique of its application.

There exists nevertheless a way, and a way full of promise, by which we may hope to improve our results with no more than the present methods of treatment: early diagnosis of the carcinoma. Both surgery and radiotherapy, whatever the technique used, give better results the earlier the carcinoma comes to treatment. Our most urgent efforts must therefore be directed to find ways and means of deters mining the presence of the carcinoma a-

* From the 2nd University Women's Clinic in Vienna, Professor W. Weibel.

early as possible, in order that it may be gotten under treatment in the earliest possible stage.

But in the early diagnosis of carcinoma by a so-called general reaction we are still far removed from our goal. All the efforts of serology and biochemistry to find a general reaction for carcinoma have failed to find such a reaction even for advanced carcinoma, to say nothing of beginning carcinoma. The reactions that are based on change in the composition of the plasma, such as the carcinoma tests of Roffo, Bottelho, Kahn, Feld and others, when tested on a large material have yielded a percentage of correct results much too low to justify their general employment. And the numerous and varied attempts of Abderhalden to determine the existence of a carcinoma from the presence of decomposition ferments in the blood have failed to yield practically useful results, notwithstanding their refinement through interfereometry by Hirsch. These methods, too, were all designed more or less for advanced carcinoma and have not proved satisfactory even for these. So much the less can they be useful for small, beginning carcinomas. It does, in fact, appear doubtful, whether a method of early diagnosis of carcinoma from the blood or the urine or the skin can ever be found; such a method would have to be based on a general change affecting the entire organism, manifested in a change in the chemical composition of the blood or the urine or in the capacity of reaction of the skin. It is very probable that no change of this sort takes place in the organism until the carcinoma has existed for a considerable time and become fairly large, when, in other words, it is no longer in the first stages; just as the Wassermann reaction to syphilis does not become positive until generalization of the infection has occurred and the stage of the primary lesion is past. Pirquet's cutaneous reaction behaves in a similar manner, and, to mention a third type of a general reaction, Aschheim and Zondek's pregnancy test does not become positive with or immediately after conception, but four weeks later, when the growing ovum has, by its size, effected a hormonal transformation in the organism. Theoretically it would be very probable that if the carcinoma really did effect a general change in the organism, this would take place secondarily at a time when the carcinoma had been in existence for some time and had attained considerable size, i.e., in an advanced and not in an early stage.

These considerations would seem to reduce considerably the prospects for a general reaction which would make possible the detection of carcinomas in the interior of the body, in the stomach, for instance, or in the pancreas, in an early stage. This should make us the more energetic in our efforts to recognize and bring under treatment as early as possible those carcinomas that are accessible to the eye through being located on a visible surface. In this group of visible carcinomas the most important are carcinomas of the skin, of the tongue, and of the portio. Carcinoma of the skin is of less importance because it is less malignant; it spreads more slowly, penetrates into the deeper parts later and only in exceptional cases does it metastasize. Even when it is not recognized and treated until a relatively late stage, the prospects of healing are incomparably better than for carcinomas of the internal organs. Radium therapy, especially, has had veritable triumphs even in advanced skin carcinomas. Carcinoma of the tongue, because of its relative rarity, does not play a very important role, and the subjective symptoms to which it gives rise usually bring the patient to the physician in time.

The conditions are different for carcinoma of the portio. Certain of the symptoms that come to the patient's attention, such, for instance, as discharge, or bad odor, do not occur in all cases; furthermore, they are frequently late in

appearing and they are by no means specific. Such symptoms are therefore often neglected and overlooked. Even when the patient does seek the gynecologist on the first appearance of such symptoms, the carcinoma may be already so far advanced that the success of treatment, whether by operation or by irradiation, is doubtful. The "meat-water" discharge, which is considered as characteristic, does not as a rule occur until the carcinoma has already broken down on its surface and has penetrated deeply, i.e., is already in a stage in which treatment is successful in at most 50 per cent of cases. Since, therefore, carcinoma of the portio does not give rise to subjective symptoms until it is in advanced stages of development and since a method of diagnosis by a general reaction does not exist and perhaps never can be found, the utmost advantage should be taken of the possibilities offered by the fact that the carcinoma is accessible to the eye.

This is the more important in that carcinoma of the portio comprises more than 90 per cent of all carcinomas of the uterus and that statistics show the latter carcinomas to be among those of most frequent occurrence. It is a fact worth remark that in Anglo-Saxon countries carcinoma of the uterus is a little less frequent. The New York Annual Report of December 31, 1929, gives the following figures for the year 1929: Carcinoma of the stomach and liver, 41 per cent; carcinoma of the female genital organs, 31.8 per cent; carcinoma of the breast, 12.3 per cent. The statistics for England and Wales, likewise for 1929, list carcinoma deaths in women as follows: Carcinoma of the breast, 19.4 per cent; carcinoma of the stomach and intestine, 31.4 per cent; carcinoma of the uterus, 14.6 per cent. Carcinoma of the uterus thus takes second or third place in frequency. The proportion of uterine carcinomas is much higher in the middle and west European countries. Imbert's statistics of 1091 cases of cancer of all organs and in both sexes for Marseilles shows: Carcinoma of the uterus, 31 per cent; of the 694 women in these statistics 333, i.e., nearly 50 per cent, had carcinoma of the uterus. In Germany about 33 per cent of all deaths from carcinoma in women are from carcinoma of the uterus. These figures show how great a rôle carcinoma of the uterus plays in the total carcinoma morbidity and mortality and how necessary is an energetic campaign against it.

In this campaign it is the earliest possible recognition of as many cases as possible that will help the most. Around 90 per cent of all uterine carcinomas arise in the portio vaginalis, only 10 per cent arise in the mucous membrane of the cervix or body of the uterus, at sites, that is, which are withdrawn from direct inspection. The 90 per cent which take their origin from the surface of the portio can be seen. A necessary condition to diagnosis by inspection is that we know exactly how a beginning carcinoma of the epithelium of the portio looks clinically on examination with the speculum. At this point the efforts of our laboratory were enlisted. The first necessity was to define as closely as possible what a beginning carcinoma is. A carcinoma that is already causing clinical symptoms, such as malodorous discharge, which presents to the examiner a clearly recognizable even though superficial ulcer, is not a beginning carcinoma in the strict sense, since already it consists histologically of many thousands of cells. Many cases have been published in which gynecologists have designated and described as "beginning" carcinomatous ulcers from 8 to 10 mm. in diameter; now it would be possible for such carcinomas to deserve the designation "beginning" in the sense that in respect to the time they have been in existence they are young, that is, that they have developed to the size above stated within a few weeks, which presupposes a rapidly growing carcinoma. But there is much to suggest, and the observations and researches that we have

made on the large material of our clinic in the last few years makes it seem highly probable, that carcinoma of the portio grows very slowly in its earliest stages. An analogy is suggested by Bowen's disease, in which frequently many years elapse before the small flecks increase in size and begin to press forward into the depths in a more rapid tempo. When, therefore, we speak of early diagnosis or of recognition of the carcinoma in an early stage, we mean, not a carcinoma that has been in existence only a short time, but a carcinoma of small extent, without regard to the fact that it is possible and probable carcinomas of the portio grow the more slowly the younger they are and probably require many weeks and months to attain or surpass a diameter of a few millimeters.

Such beginning carcinomas are in general so small that they escape the examining eye. In my first investigations I laid it down as a basic condition for the classing of a carcinoma among beginning carcinomas that it must be so small as not to be recognizable with the unaided eye. It follows from this definition that such beginning carcinomas can be discovered only under the microscope and that a lucky chance is needed for their detection. Now the area of the portio is so small that the possibility exists of creating this lucky chance systematically by examination, according to plan, of a sufficiently large number of uteri. With this end in view we have for several years systematically submitted to histologic examination in radial sections the portio of every uterus which was operated on in our clinic; among them we found a number of beginning carcinomas and in this way we acquired an exact knowledge of beginning carcinomas. I found cases in which the epithelium immediately at the external os was changed in exactly the same way in which we find it changed in the marginal areas of advanced carcinomas. In their book on carcinoma of the uterus Kermauner and Schottländer have described cases in which advanced carcinomas run out in a narrow epithelial coating, which, though sharply demarcated, is in direct connection with the neighboring epithelium and in the polymorphism and non-conformity to type of its cells bears a complete histologic resemblance to carcinoma tissue. These so-called carcinomatous coatings are found in the marginal area of a small percentage of advanced carcinomas.

By the systematic examination, continued over a number of years, of all the uteri extirpated in the clinic, I have been able to establish a series of pictures showing a continuous development from early stages, before unknown, up to the well-known advanced forms of carcinoma. The first stage shows a small carcinomatous coating, directly at the external os, of the same thickness as the existing normal epithelium and standing in direct connection with the normal epithelium, but sharply demarcated from it. There is complete absence both of deep penetration and of superficial breaking down. The second phase shows one or two small cones penetrating downward, but still no ulceration; in the third stage there is superficial breaking down and growth into the deep parts through the penetration of cones into the stroma and greater extent on the surface. In this third phase are already seen all the characteristics of the advanced carcinoma, except that the proportion of that part that is in the deep tissues and that part that is on the surface is greatly in favor of the latter, which often accounts for nine-tenths of the entire carcinoma mass, while only one-tenth has grown downward. In the further development of the carcinoma to the forms long known and studied the deep growth increases disproportionately, the superficial breaking down makes further progress, while the carcinomatous coating at the margin forms only a small fraction of the whole carcinomatous mass or finally disappears altogether.

With these findings the picture of the beginning carcinoma was histologically established. There remained only the

problem of finding a clinically usable method by which the rapid diagnosis of such a beginning carcinoma would be possible on speculum examination. The thorough examination of numerous beginning carcinomas failed at first to suggest any solution to this problem. In the very earliest stages of carcinoma formation the surface of the portio carcinoma is not broken down, it does not give the picture of a superficial ulcer or of an erosion. The first phases of carcinoma formation consist in a carcinomatous transformation of the superficial squamous epithelium without ulcerous degeneration. On the other side, the beginning carcinoma does not as yet show any deep growth, it has not as yet sent any cones downward; it would therefore be futile to search the deeper layers of a biopsy specimen for carcinomatous trabeculae which at this stage do not exist. The carcinoma consists, as stated, only in a carcinomatous change of the superficial epithelium, characterized histologically by a retracing of differentiation, by polymorphism and by atypicalness; wherein, nevertheless, the carcinomatous epithelium stands in close connection with the normal, and the inflammatory infiltration beneath the carcinomatous epithelium stops abruptly at the boundary between the carcinomatous and the normal epithelium. (Fig. 1.)

Macroscopically the beginning carcinoma may be recognizable in this phase by the fact that the carcinomatous epithelium is dull, not transparent and frequently yellowish in hue, contrasting in its lusterless, somewhat elevated surface with the surrounding smooth, glistening, transparent, normal epithelium of the portio. Inspected more closely, it appears as a small, usually sharply contoured whitish spot on the surface of the portio, which, like similar changes on the tongue, in the esophagus or the bladder, is termed leucoplakia. But these leucoplakias are often so small that they escape careful observation; many times their development is so indistinct that they are overlooked even on thorough examination.

Our task was now to find a method of making such manifest or latent leucoplakias stand out so clearly that they could not be overlooked even on rapid examination. For this purpose I tried vital staining with a large number of dyes, but without obtaining usable results. The high molecular dyes stain only necrotic cells and leave living cells entirely unstained. The readily diffusible dyes, such as neutral red and light green, do indeed stain living cells, but without any distinction between normal and carcinomatous cells. The basis for a differentiation through vital staining would be the presence of a substance occurring only in cancer cells and absent in normal cells, or vice versa. But up to the present we do not know of any such substance, and if one should be found there would still be the difficulty of demonstrating it by selective vital staining in the portio of the living patient.

Fig. 1. Beginning carcinoma at external os.

The method of vital staining was, therefore, impracticable, but another biochemical finding proved capable of development: it was discovered that the glycogen that is regularly present in large quantities in the normal epithelium of the portio disappears as at one stroke with the change of the epithelium into carcinoma. Even the epithelium of the fetal portio contains large quantities of glycogen in its upper layers and this type of differentiation is retained by the epithelium of the portio and vagina throughout life. Hormonal activity exerts an influence on the quantity of glycogen in the sense that increased production of the ovarian hormone stimulates production of glycogen in the epithelium, but the influence of the ovarian hormone is to be understood only as a stimulative influence and in no wise as the cause of the production of glycogen, since the epithelium of the vagina and portio of castrated women and of women past the menopause regularly contains large quantities of glycogen. For the epithelium of the vagina and portio, as for that of the esophagus, differentiation in this direction is specifically and permanently established, whereas the epithelium of the skin produces glycogen only in the early, fetal stage and later, with differentiation to horn-forming epithelium, loses completely the capacity to form glycogen. These two directions taken by differentiation, the formation of horn and the formation of glycogen, are in general mutually exclusive; when, for instance, in cases of prolapse the epithelium of the portio undergoes cornification, it no longer forms or contains any glycogen, and in the same manner it loses the capacity to form glycogen when it undergoes carcinomatous degeneration. (Fig. 2.) In glycogen we have a biochemically demonstrable element by which it is possible to distinguish carcinomatous from normal epithelium from the fact that normal epithelium almost always contains glycogen and carcinomatous epithelium never.

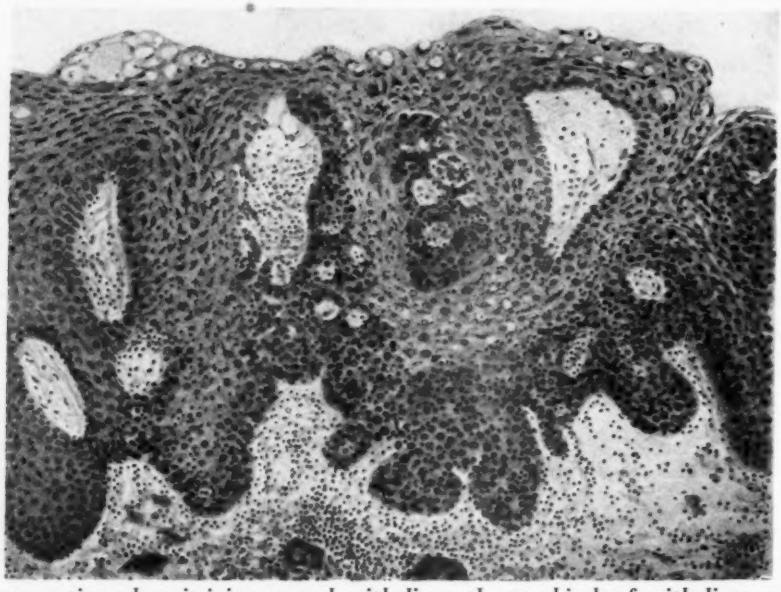


FIG. 2. Carcinomatous coating where it joins normal epithelium; the two kinds of epithelium are interdenticulated. Normal epithelium contains glycogen, carcinomatous does not. Best's staining method.

It must be emphasized that the glycogen here concerned is the so-called epithelial glycogen, which is wholly insoluble in water, as distinguished from muscle or liver glycogen, which dissolves at once in water. Soaking pieces of tissue or sections in water, even for hours, has no effect on the demonstrability and staining of this glycogen, whereas the water-soluble liver glycogen is no longer demonstrable after the tissue or section has been in water for

a few seconds. In a few cases glycogen has, indeed, been demonstrated in uterine carcinoma (Lubarsch, Babes and Lafarescu,

Fig. 3. Pouring Gram's solution into vagina by means of a vessel with a long lip.

Pantzu), but in these exceptional cases, which practically play no rôle, the glycogen was water-soluble, of the type of liver glycogen, and not the water-insoluble epithelial glycogen.

We have two methods for demonstrating and staining glycogen: staining with alkaline carmine according to Best and staining with iodine. The staining with carmine is eminently suitable for histologic purposes, but is impossible as a vital staining since because of its strong alkalescence the dye solution causes immediate swelling of the tissue and thereby injures it. Staining with iodine, on the other hand, can be used without any trouble as a vital staining method. When the epithelium of the portio is brought into contact with an aqueous solution of iodine, the glycogen contained

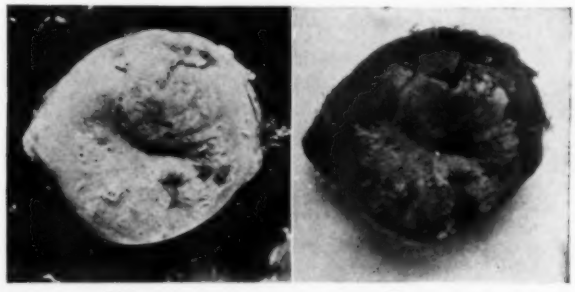


Fig. 4A. Fig. 4B.

Fig. 4. Portio with flat, superficial beginning carcinoma (A) before iodine painting, (B) after iodine painting.

Fig. 5A.

Fig. 5B.

Fig. 5(A). Scraping: On left, above, normal squamous epithelium, with wide, superficial, spongy, glycogen-containing layer; on right, below, carcinomatous epithelium without a spongy, glycogen-containing layer with polymorphous nuclei.

Fig. 5B. Juncture of beginning carcinoma on left with normal epithelium on right.

in the superficial layers takes rapidly a dark brown color and the tissue is not injured in any way. But if for any reason

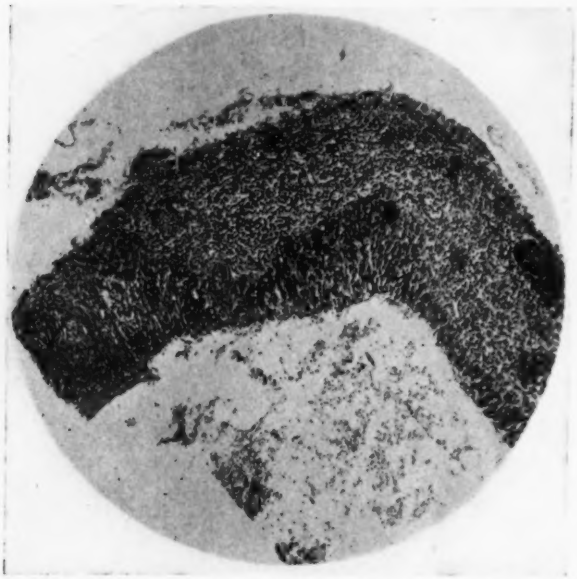


Fig. 6a. Scraping from tissue shown in Figure 6b. Carcinomatous epithelium with polymorphous and atypical cells; stroma shows dense inflammatory infiltration.

the glycogen is absent the epithelium remains white and unstained. For the staining only aqueous solution of iodine in the form of the so-called Gram's solution should be used and not alcoholic tincture of iodine, since the latter coagulates the tissue by its alcohol content and in a short time penetrates the coagulated tissue without any distinction, whether this contains glycogen or not. By preference we use the so-called Gram's solution, consisting of 1 part iodine to 2 parts potassium iodide and 300 parts water. It causes fine differences to stand out more distinctly and gives sharper differentiations than the more rapidly acting but much more diffusely staining Lugol's solution of high concentration.

The procedure for staining is as follows: Under speculum control the portio is cleansed of mucus or discharge with the aid of cotton. Then from 20 to 30 c.c. of Gram's solution are poured on to the portio from a glass vessel having a sharply pointed lip and is carefully distributed with a cotton pledget, so that no folds or indentations shall remain unmoistened. After about thirty to forty seconds the

Fig. 6b. Beginning carcinoma at external os: On left normal epithelium; on right, above cystic cervical glands, carcinomatous epithelium with dense inflammatory infiltration of stroma; normal and carcinomatous epithelium of equal width.

Gram's solution is absorbed with a pledget of dry cotton, the portio is wiped off superficially and is then carefully examined for staining. A normal portio, covered throughout with normal, glycogen-containing epithelium, stains more or less evenly a dark brown. If any place remains white or unstained, it is suspicious for carcinoma, but failure to take the stain is by no means definitely specific for carcinoma. There are other pathologic conditions in which the epithelium loses its glycogen content and consequently remains white and unstained after painting with

iodine. The decision whether carcinoma or one of these other, noncarcinomatous pathologic changes is present can in general

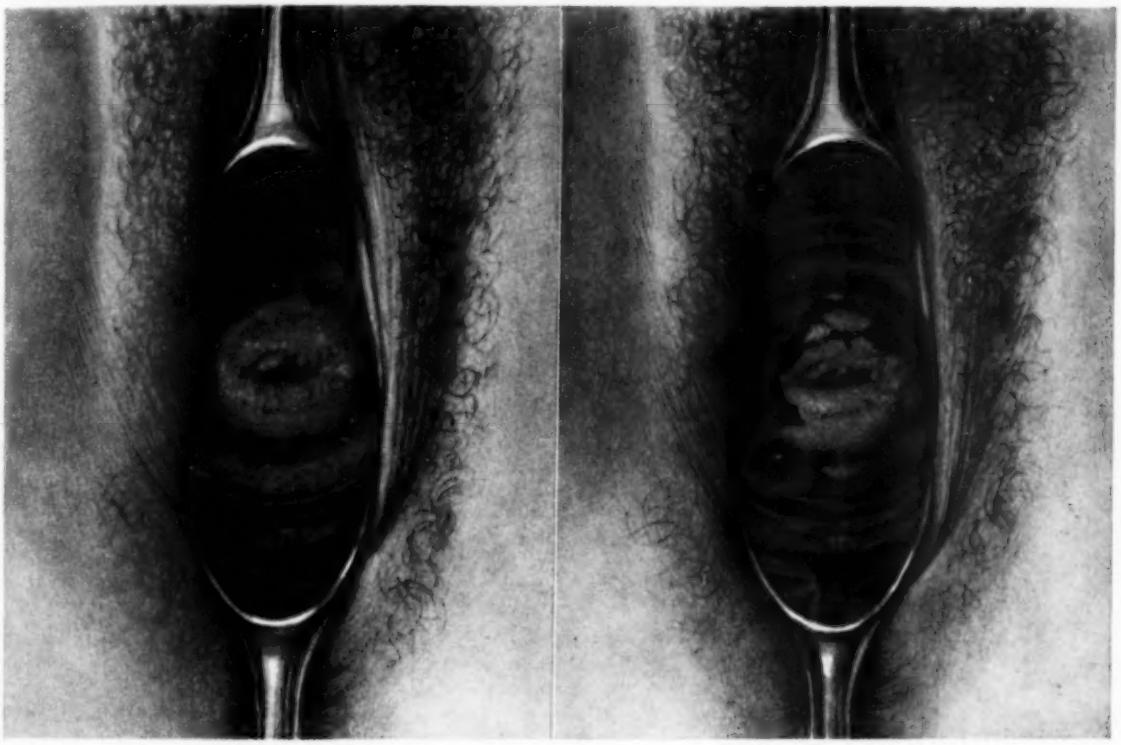


FIG. 7A. FIG. 7B.

FIG. 7A. Portio with extensive circular erosion, adjoining epithelium apparently normal.

FIG. 7B. Portio after iodine painting: On posterior lip of portio an unstained, white field (superficial beginning carcinoma adjoins erosion, which is unchanged in its coloring. On anterior lip are three smaller light spots, with notched contours, separated from each other and from erosion by normally brown-stained epithelium, i.e., epithelial defects, probably caused by introduction of speculum.

be made only by histologic examination of the suspicious epithelium. For this purpose we have used as a rule not biopsy but scraping, removing suspicious, unstained epithelium with the small spoon. Fixation is best carried out with Carnoy's mixture, in which the fragments of epithelium remain for from two to three hours, after which the fluid is poured off and replaced by absolute alcohol, without previous soaking of the fragments in water. In this way we not only save time but avoid the danger of losing small bits of tissue in the process of washing. The imbedding in paraffin over alcohol and xylol, and the cutting and staining with hemalum-eosin are carried out by the usual methods. The histologic diagnosis is based exclusively on the atypicalness and polymorphism of the epithelium, especially the irregularity in the arrangement and distribution of the nuclei. The alternation

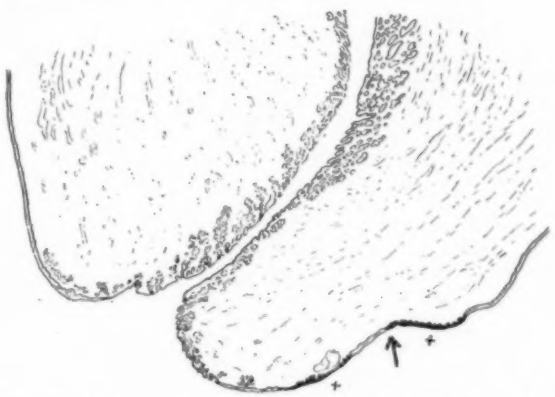
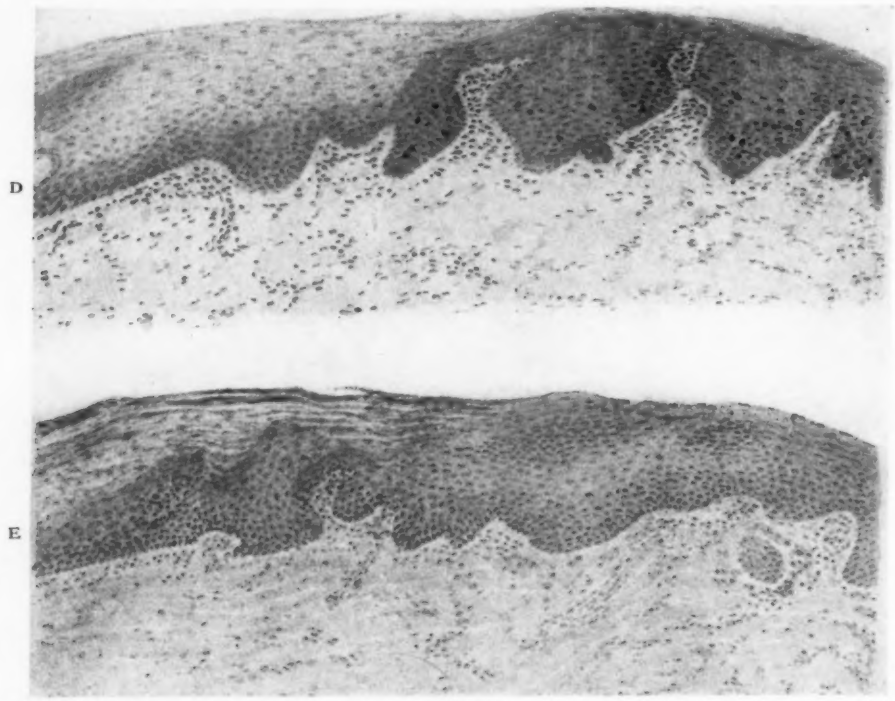


FIG. 7C. Schematic sagittal section through portio; small sketch on right shows direction of section; on posterior lip it cuts through (1) erosion, (2) normal epithelium, (3) carcinoma (indicated in black), (4) normal epithelium, (5) carcinoma, (6) normal epithelium. (Figs. 7D and E show spot to which arrow points.)

of large and small, light and dark nuclei, the appearance of abnormal and bizarre-

shaped nuclei serve as diagnostic criteria. Whoever examines such scrapings for the first time will, indeed, frequently encounter



FIGS. 7D and E. Junction of normal and carcinomatous epithelium (normal on left, carcinoma on right), (D) without hemalum staining, (E) after glycogen staining according to Best.

certain difficulties, but with practice and experience the making of the diagnosis becomes very much easier. (Figs. 5 and 6.)

As has been said, the picture of leucoplakia is in no wise specific for carcinoma; any change in the epithelium of the portio that is associated with loss of glycogen is able to produce the picture of leucoplakia. The following changes call for consideration here:

1. Carcinoma: It is characteristic of carcinomatous leucoplakia that it almost always is situated on the margin of the external os or of the inner boundary of the squamous epithelium and appears as a sharply demarcated spot, almost always single.

2. Cornification: This develops regularly in cases of sinking or prolapse, it differs from carcinoma in its irregular shape, in its diffuse demarcation, and also in the fact that it often forms multiple spots at considerable distance from the external os, which carcinomatous leucoplakia never does.

3. In syphilis and also in leucemia, leucoplakias appear in the form of small white spots which can hardly be distinguished from carcinomatous leucoplakias, but their occurrence is very rare.

4. Traumatic epithelial defects, in which the superficial, glycogen-containing layers of the epithelium have been scraped off by the introduction of the speculum or by too energetic cleansing of the portio, likewise appear as white spots after the painting with iodine; but they can be readily recognized by their sharp linear delimitation, which characterizes them immediately as the effects of scratching. Also, they always lie a little below the level of the rest of the epithelium, which frequently betrays the traumatic origin of the defect by small tears or projections.

In any case, histologic examination after removal of the suspicious area with the spoon is just as essential as after biopsy excision; a judgment formed on macroscopic examination is not sufficient in a decision so important to life as confirmation or rejection of the diagnosis of car-

cinoma. The relation of erosion to beginning carcinoma after painting with iodine deserves a special word. In the first two stages the erosion consists superficially either of stroma without epithelium or of stroma covered with cervical epithelium. In neither of these two cases does the surface of the erosion harbor glycogen; therefore on the examination it does not stain brown but keeps its reddish color. Since the earliest stages of the development of the carcinoma take place in the squamous epithelium, these two forms do not come into consideration in the diagnosis of beginning carcinoma. The situation is different in the third healing stage of the erosion, in which the surface of the squamous epithelium is already again overgrown; in this case a carcinoma can very well start in the superficial squamous epithelium. It makes no difference whether the carcinoma develops in the normal

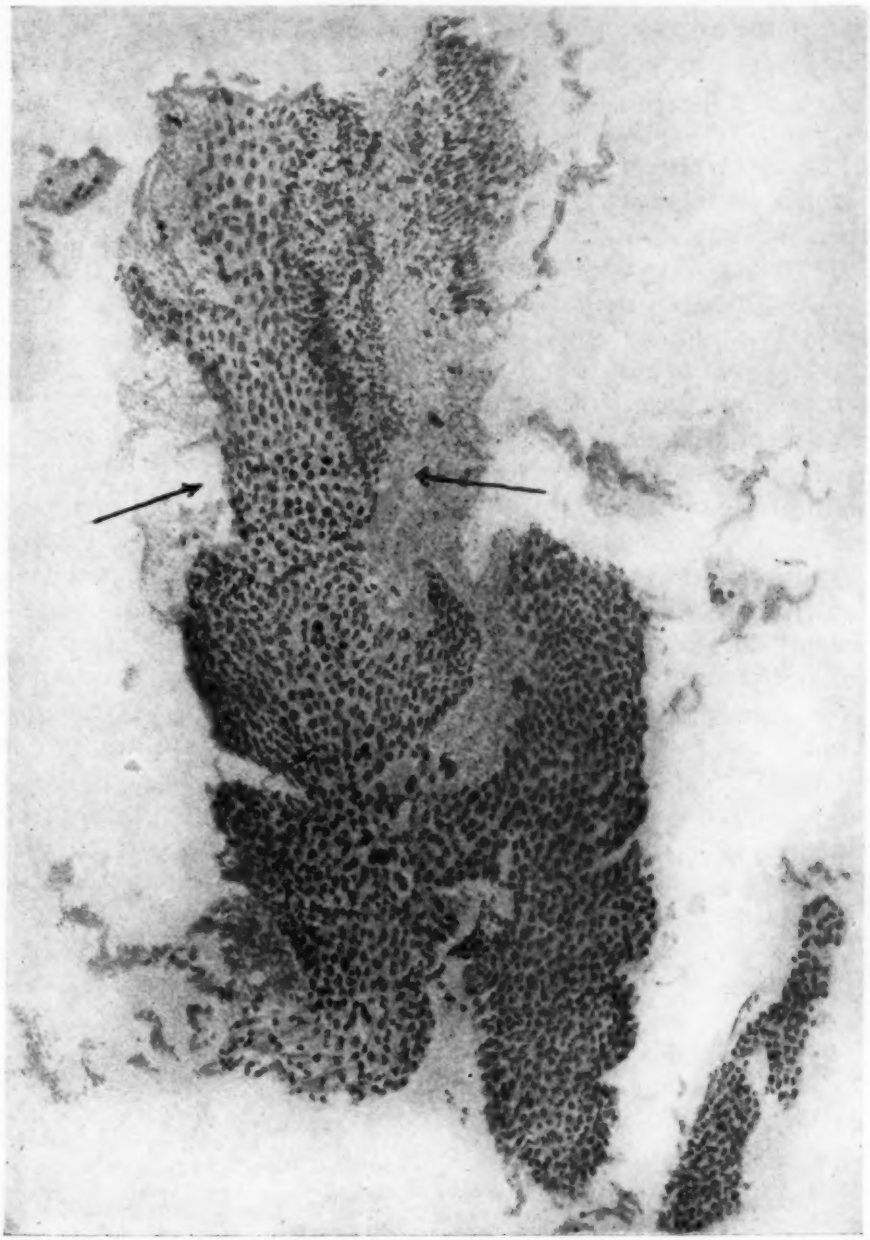


Fig. 7f. Scraping from beginning carcinoma; arrows show sharp junction between normal and carcinomatous epithelium, with numerous mitotic cells.

epithelium or in the squamous epithelium which forms the surface of a healing erosion. In both cases the painting with iodine causes it to appear as a white spot. The first two forms of the erosion, the erosion with surface uncovered by epithelium and the first stage of healing of the erosion, with cylindrical-cell epithelium on the surface, might under certain circumstances be confused with a shallow carcinomatous ulcer. In this case, however, the lesion would have to be an already advanced carcinoma, in the stage of superficial ulcerous degeneration, and not a carcinoma in the first stage. For the diagnosis of a carcinoma in this advanced stage Chrobak's test with the sound and then possibly a biopsy excision must be done. The beginning carcinoma in its very first stages does not take the form of an ulcer, which because of its rough, reddish surface might be confused with an erosion or even with the first healing stages; it consists, rather, in a change of the macroscopically white, smooth squamous epithelium, and must therefore be sought there. (Figs. 7 A–D.)

It will, of course, be understood that a negative result from the painting with iodine, i.e., the even staining of the entire portio, is of diagnostic significance only in so far as it shows that the epithelium of the portio is everywhere normal and harbors no beginning carcinoma. As to the upper parts of the uterus, the mucous membrane of the cervix and corpus, such a result from the painting with iodine says nothing. If there is any reason to suspect that the patient has a carcinoma of the uterus and the painting with iodine results in uniformly brown staining of the portio, then the carcinoma must be sought in the upper parts of the cervix or the corpus mucous membrane.

The advantage of the painting with iodine lies in the facts that it is easily carried out and causes the patient no pain. On the other hand, it is possible with this method to find a carcinoma of the portio in so early a stage that the prospects for cure are almost 100 per cent. Its systematic employment could lead to an improvement in our results in one of the most widespread and dangerous of carcinomas such as is not possible today by any other means.

SUMMARY

Since our present methods of treating carcinoma are virtually the same as they were a generation ago and nothing new has been discovered that will increase our effectiveness against it, our only hope at present lies in early diagnosis.

Carcinoma of the portio comprises more than 90 per cent of all carcinomas of the uterus and carcinoma of the uterus is the underlying cause of from 15 to 30 per cent of all deaths from carcinoma in women.

This simple test presented here is positive for the absence of carcinoma on the exposed portion of the cervix but requires a sufficient knowledge of microscopic pathology.

REFERENCES

Graves. The detection of the clinically latent cancer of the cervix. *Surg. Gynec. Obst.*, 56: 317, 1933.

Schiller. Early diagnosis of carcinoma of the cervix. *Surg. Gynec. Obst.*, 56: 210, 1933.

SCHILLER'S TEST FOR EARLY SQUAMOUS-CELL CARCINOMA OF THE CERVIX

CHARLES EDWIN GALLOWAY, M.D., F.A.C.S.

EVANSTON, ILL.

SINCE the development of surgery and the discovery of *x*-ray and radium as a treatment of cancer, there has been nothing new discovered which has increased our ability to cure this disease. It is also a well-established fact that our treatment yields the best results among the group of carcinomas that are classed as early. It would seem reasonable, therefore, that anything which enables us to make an early diagnosis of cancer without the expenditure of too much energy, money or time is worthy of thorough investigation and trial.

Schiller's iodine test showing glycogen-free areas has the advantage of being very simple, painless, requiring no special expensive apparatus and consuming very little time. It does require some experience, however, and it also requires the assistance of a well-trained pathologist capable of making a diagnosis with small pieces of tissue. We have come to realize that large pieces of tissue are not necessary. Nor is it necessary to send the patient to the hospital to obtain the tissue, thereby causing her considerable expense. The tissue needs to be only epithelium, obtained, if possible, at the border between normal and glycogen-free cells. The diagnosis of squamous-cell carcinoma of the cervix is best confirmed with the higher power lenses if the area is small. We no longer look upon down growth and large areas of tissue as necessary. The day will probably come when with the high power microscope and special staining we will be able to recognize malignant cells in very small groups.

Only about one out of 5 cases that show an iodine-free area after painting will be malignant. Even that small number, however, justifies carrying out the examination. As times goes on and early carcinomas are seen, one's knowledge of just how the area looks enables him to detect the next one more easily. Since the procedure consumes very little time and causes no pain, it will serve a good purpose if it will but cause the average practitioner to inspect the cervix thoroughly.

The test is for use principally in the office in making routine or periodic examinations. If the patient comes with symptoms of cancer, then she should be hospitalized and have not only a biopsy but a curettage for diagnosis. If, however, she presents herself for routine or periodic examination, Schiller's test should be done for, as the late W. P. Graves[1] said in his last paper, "It is specific for the absence of cancer" (meaning of course on all exposed or visible surfaces). I had the privilege while working with Dr. Schiller of seeing several very early squamous-cell carcinomas of the portio discovered in women coming to the Weibel Clinic. They were not complaining of anything relative to the pelvis when they came.

In Schiller's papers and in Graves' also the word "Lugol's" has been used to designate the solution. It is not Lugol's solution, however, but Gram's solution and the word "Lugol's" has led many men to use a solution of iodine that is much too strong and therefore unsatisfactory. I have, therefore, taken the privilege of substituting the work "Gram" solution in Schiller's article wherever the work "Lugol" was used, for the formula as he

[1] Graves, W. P. *Surg. Gynec. Obst.*, 56: No. 2A (Feb. 15) 1933.

gives it is: iodine 1, potassium iodide 2, and water 300.

When an iodine-free area is seen, the tissue needed is only epithelium, not the underlying tissue. It can be obtained in several ways. I prefer a small, sharp, cut-shaped tissue punch. The raw surface is then cauterized with the electric cautery. If bleeding occurs, the vagina can be packed with gauze for eight to twelve hours. The small scrapings are more difficult for the technician to work with but they can be prepared in paraffin blocks much quicker, especially if one puts them in Carnoy's solution which contains no water and from which they can be taken quickly into paraffin. This solution causes marked shrinking, however.

For years we have advised women to be examined periodically but we had little to offer them from the standpoint of early discovery of cervical cancer. Even when we saw an abnormal cervix, we were unable to say which one needed biopsy or where the biopsy should be taken. Schiller's simple test offers a little further justification for our asking women to present themselves for examination at stated intervals.

SUMMARY

Schiller's iodine test showing glycogen-free areas is a simple, painless procedure requiring no expensive apparatus and consuming little time. Gram's solution is used.

Small pieces of epithelium only are required for pathologic examination, obtained from the iodine-free area, if possible at the border between normal and glycogen-free cells.

The test is primarily for office routine or periodic examinations, for patients who have no symptoms of cancer.

REPLACEMENT OF THE UTERUS POST PARTUM

AND ITS BENEFITS

LOUIS DROSIN, M.D.

NEW YORK CITY

NOT every woman after childbirth is fortunate enough to have all her pelvic organs normal and healthy; but she does expect, and justly so, to be left no worse than before. However, this ideal of obstetrics is by no means always fulfilled, as any gynecologist can testify.

Miller[1] says:

> I am a gynecologist, and I do not hesitate to say that day in and day out 50 per cent of the women who come to my office come there for diseases which could have been aborted in their incipiency, for diseases which need never have occurred if their confinements had been properly handled. I am a surgeon, and I do not hesitate to say that my surgical practice would be cut in half if there could be eliminated from it the preventable gynecologic complications of obstetrics.

For the preservation of the mother's life, as well as for the preservation of her health, the conduct of the third stage of labor, i.e., after the delivery of the child, is at least as important as that of the other two stages. For as De Lee[2] points out, "more women die from accidents of the third stage of labor than during the other two combined. . . . "

> On a proper conduct of this part of the delivery depend the woman's freedom from postpartum hemorrhage, the expulsion of the secundines complete, the smooth convalescence during the puerperium, and even her health later in life. Postpartum hemorrhage may be directly fatal, or may leave the woman permanently invalided; retention of pieces of placenta may be the cause of puerperal infections and lay the foundation for ineradicable disease. [DeLee.[2]]

I have found, however, that no matter how careful the technique employed in the delivery of the child and the expulsion of the placenta, the uterus, with its supports and adnexa, is still left in a state of distortion and on a level so low in the pelvis that it cannot always rise spontaneously out of it. Help on the part of the attendant is therefore indicated, and the procedure that I have used is demonstrated in the accompanying illustrations.

The fingers are here shown placed above the symphysis and pressure exerted at first in a direction downward and backward (Fig. 1) and then backward and upward (Fig. 2), and as the uterus rises and anteverts, it is thus sustained for a few minutes until it is firmly contracted. As a result of this procedure the uterus becomes and remains firmly contracted and is raised out of the pelvis to a relatively normal state of anteversion. The uterine supports and vagina are helped to regain their normal tonicity; and hemorrhage, subinvolution, prolapse and retroflexion are minimized or entirely obviated.

During and immediately after delivery of the placenta, the cervix is so low down in the vagina that in multiparae it can usually be seen at the introitus. While replacing the uterus the vagina is drawn on the stretch, so much so that a perineum which is gaping as a result of previous labor will temporarily close. The fundus at the end of twenty-four hours postpartum will be found, usually, at or somewhat below the umbilicus instead of two or three fingers above this landmark.

For the same reason that the uterus contracts rapidly and enduringly when replaced, if this is done before the delivery of the placenta, it will facilitate its separation and diminish profuse bleeding. Bleed-

ing of hemorrhagic proportion after delivery of the placenta, and regardless of cause, has been successfully controlled in

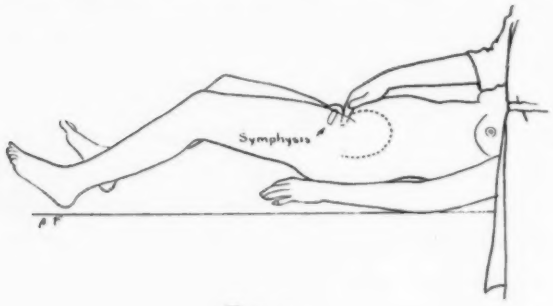


Fig. 1.

With this method as described at that time, the uterus was pulled, rather than pushed, upward by grasping the fundus

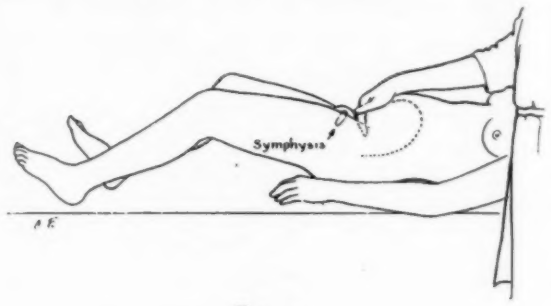


Fig. 2.

the majority of cases by the same maneuver, by simply maintaining the replaced uterus in an attitude of exaggerated elevation and anteversion for an additional few minutes. These results have undoubtedly been accomplished by the kinking, traction or compression of the blood vessels until the contraction and retraction process of the uterine musculature permanently obliterated the bleeding points. Inspection of the cervix after the hemorrhage was controlled usually revealed deep tears, a few of them extending into the vaginal vault.

I have been demonstrating this method of replacement of the uterus to internes, and have been practicing it for at least ten years with gratifying results. A review of obstetric literature on the third stage of labor and the prevention of the complications of this stage shows that any maneuver for pushing the uterus upward out of the pelvis either before or after the expulsion of the placenta is not commonly employed, and only very few obstetricians have used such a procedure, none of them exactly the same as the one I have described.

In 1899, Dickinson[3] advised lifting and manipulating the uterus through the relaxed abdominal wall for the control of postpartum hemorrhage after delivery of the placenta. In his original article, he said: "The elasticity of the recently stretched vagina and the flabbiness of the lower uterine segment and cervix allow the corpus to make a considerable excursion upward."

through the abdominal wall and lifting the uterus entirely out of the pelvis. This was done with the left hand, while the right hand was applied to the lower segment of the uterus as follows:

> The right hand is arched (the thumb spreading away from the fingers), the ulnar border resting against the symphysis, while the finger tips and the thumb encircle the narrow and relaxed lower uterine segment and neck of the uterus as far as they may. The bowed hand seizes and manipulates the parts it can compass; the other hand grasps the fundus and makes active friction and compression of the thick ball-shaped body of the uterus above for which the promontory and all the lumbar spines afford a surface for counterpressure.

This method of Dickinson's was not widely adopted. No mention is made of it in standard textbooks of obstetrics except that Polak[4] refers to it briefly as one of the methods of controlling postpartum hemorrhage; i.e., "by lifting the uterus out of the pelvis, constricting the lower segment by grasping it and compressing it against the sacral promontory, while the fundus is pressed against the vertebral column."

Fifteen years after Dickinson's first description of this method was published, it was adopted in modified form by the late R. H. Pomeroy of Brooklyn, and used in any case showing a tendency to postpartum hemorrhage after expulsion of the placenta. Pomeroy's procedure differed from Dickinson's in that he did not pull the uterus upward by grasping the fundus,

but raised it out of the pelvis, "by exerting pressure backward and upward with his fingers placed just above the pubes." For this purpose Pomeroy

> . . . took a position at the right side of the patient, and placed his right hand, ulnar border down, across the lower uterine segment, and exerted pressure upward and backward against the spine. . . . At the same time he placed his left hand, ulnar border down, just above the fundus. He thus held the uterus, as one might hold a ball, between his two hands, and could compress it, exert stimulation and prevent the organ from ballooning with blood. [Smith.[5]]

This method is still employed at the Brooklyn Hospital for the control of postpartum hemorrhage, but only after the expulsion of the placenta.

In 1919, Fuchs[6] advised pushing the uterus upward after the expulsion of the placenta to aid the separation of the membranes.

In 1925, James Hendry[7] described a method for pushing the uterus upwards out of the pelvis after the delivery of the child, which he stated he had not found described "in any of the textbooks or in any individual communication." The possibility of this maneuver, he notes, depends upon the great mobility of the uterus after the second stage of labor.

By Hendry's method, the right hand of the obstetrician is placed over the lower portion of the uterus, the palm "directed towards the position of the sacral promontory," and the uterus pushed out of the pelvis. This pressure can be further supplemented, he says, "by placing the upper or left hand above and behind the body of the uterus and bringing it forwards and downwards. By this means it is possible to control the whole bulk of the uterus between the two hands placed on the surface of the patient's abdomen." This lessens the amount of bleeding from the uterus by traction; but if further control of bleeding is desired, the thumb and fingers of the hand over the lower portion of the uterus may be pressed close into the sides of the uterus, thus "bringing practically direct pressure on the main uterine vessels at their entrance to this organ."

Hendry regards the control of postpartum hemorrhage as "perhaps the most valuable use of this position of the uterus." But he notes that it is also of value to prevent tearing and retention of the membranes after the placental mass has escaped from the vagina. For, "if when the placenta is just escaping from the vulva, its weight is supported, the membranes may be stripped very satisfactorily by pushing the uterus gently upwards and backwards so as to peel them off without tearing." It is also of value when forcible expulsion of the placenta is necessary, to avoid any risk of inversion.

In extremely obese women, he has found it necessary in some cases to exert more forcible pressure, "driving the uterus upwards and backwards by means of a closed fist pressed towards the sacral promontory."

In a recent (1933) article Brandt[8] states that he has used the Dickinson-Pomeroy method for the control of postpartum hemorrhage for several years, and that more recently he has employed the same maneuver to aid the delivery of the placenta after its separation.

For this purpose, no abdominal manipulation is attempted for five or ten minutes after the delivery of the child, during which period the child is cared for and the perineum inspected. The separated placenta should then be in the cervix and upper vagina. The umbilical cord is clamped close to the vulva and held in one hand; the other hand is placed on the mother's abdomen so that the thumb lies parallel to the symphysis and the palm and fingers approximate the uterine body. A gentle upward push is made on the lower segment by this hand without grasping the uterus. If the placenta lies in the cervical canal or upper vagina, the uterus rises without causing tension on the umbilical cord. If this is the case, "a further series of gentle pushes" causes the uterus to rise further, while the placenta

remains in the vagina. If the first upward push causes tension on the umbilical cord, no further attempt to push the uterus upward is made for several minutes. This failure of the uterus to rise when pushed is due most frequently to contraction of the cervix, which holds the placenta in the cervical portion of the uterus, and it is necessary to wait for it to relax. When the uterus has been pushed up high in the abdomen, it is held in that position between the hands of an assistant for fifteen minutes. The placenta is expelled downward by gentle pressure just above the symphysis, and any necessary perineal repair is done.

As shown by the illustrations, my method of pushing the uterus upwards differs from any of these described and was developed entirely independently. Only by means of this unilateral method can the fingers reach below the cervix and the uterus be completely elevated and sustained until the desired result is obtained, without the encumbrance or counteraction of the other hand. This fact has been corroborated in the course of my observations on the mechanism and signs of separation of the placenta[9] with the fingers in the vagina. It was also observed that the internal os or contraction ring forms instantly after the delivery of the placenta and that the lower border of this ring, in the course of replacement of the uterus by this method, rests entirely on the fingers employed for this purpose. It was not desired as a method of controlling postpartum hemorrhage primarily, although it does this satisfactorily, but a routine method in the conduct of labor. It may be done either after the expulsion of the placenta or before, as seems desirable in each case. Not only does it control hemorrhage, assist expulsion of the placenta and the membranes, as noted, but also hastens involution of the uterus and aids it in regaining its normal position. When pushed upward in the manner described, the uterus contracts rapidly. Brandt[8] has also noticed this fact and attributes it to "anemia of the musculature" of the uterus resulting from the traction or compression of the blood vessels.

An important result of this procedure as a routine, not noted for the other methods described, is that it diminishes the incidence of postpartum retroversion of the uterus. The true incidence of retrodisplacements due primarily to pregnancy and labor is not known. Miller[1] is of the opinion that "the majority of retroversions develop within the first months after delivery and prophylaxis at this time will abort most of them." Even if this estimate is a little high, it is certain that a considerable percentage of retroversions do result from failure of the uterus to regain its normal position after labor, as may be seen from the various methods proposed to prevent such retroversions in the puerperal period: postural exercises, etc.

With the simple method that I have described, I have rarely seen a puerperal retrodisplacement of the uterus except where there was a history of such a displacement prior to pregnancy. Hence I would urge the routine use of this method of replacement of the uterus at the time of labor, because of its simplicity and its effectiveness in the control of many of the serious complications of the third stage.

SUMMARY AND CONCLUSIONS

Prevention of retrodisplacement and prolapse of the uterus postpartum was my primary object in replacing it after the delivery of the placenta. It was found that it does so satisfactorily in the former instance and appreciably so in the latter. Its routine use further revealed that involution of the uterus is more complete and more rapid and in some cases it is so rapid and sustained that, instead of the usual after pains the patient experiences a continuous pain or soreness over the uterus. For the same reason that it contracts and retracts rapidly, it will prevent hemorrhage in cases so predisposed and where

it had repeatedly taken place during previous labors. It will likewise control hemorrhage in the majority of cases. When used before the delivery of the placenta it will hasten its separation. After the separation of the placenta it can be used, if desired, advantageously, instead of the Hendry or Brandt procedure.

All these can be accomplished successfully only when the uterus can be "elevated" as if by a lever, and so maintained, instead of being pushed or pulled up and manipulated between both hands. In the latter instance one hand is apt to counteract the action of the other to a degree sufficient to defeat the purpose for which it is intended. Neither can the palm of the hand and its ulnar surface penetrate deeply, and backward and upward sufficiently behind the symphisis and below the uterus as will the tips of the fingers.

Once the uterus is elevated, the blood vessels react quickly to the traction, kinking, or compression, or all combined, to which they are now subjected. This action is further enhanced by the unencumbered and undisturbed contraction and retraction process of the uterine musculature.

The employment of the unimanual method is not conditional on the laxness of the abdomen or the mobility of the uterus or contraindicated by the presence of obesity or any other condition, with the exception of a distended bladder, for the tips of the fingers will penetrate deeply enough where other methods will fail. There is only one condition where it absolutely can not be employed and that is when the uterus and its supports, soon after delivery of the placenta, become so firmly contracted and are drawn down so low in the pelvis in a state of fixity, that even an attempt at replacement is impossible. But these cases progress splendidly without it.

The routine employment of this method cannot be urged too strongly.

REFERENCES

1. Miller, C. J. Gynecologic backwash of obstetrics. *Southern Surg.*, 1: 301 (Jan.) 1933.
2. De Lee, J. B. Principles and Practice of Obstetrics. Ed. 6, Phila., Saunders, 1933.
3. Dickinson, R. L. Lifting and manipulation of the uterus through the abdominal wall to control post-partum hemorrhage. *Brooklyn M. J.*, 13: 137, 1899.
4. Polak, J. O. Manual of Obstetrics. Ed. 2, N. Y., Phys. & Surg. Book Co., 1922.
5. Smith, W. S. Postpartum hemorrhage. *New York J. Med.*, 31: 141, 1931.
6. Fuchs, H. Der Freund'sche Handgriff zur Entfernung retenierter Eihante in der Placentarperiode. *Zentralbl. f. Gynäk.*, 43: 769, 1919.
7. Hendry, J. The mobility of the uterus as a factor in the care of the third stage of labour. *Tr. Edinb. Obst. Soc.*, 45: 153, 1924–25.
8. Brandt, M. L. The mechanism and management of of the third stage of labor. *Am. J. Obst. & Gynec.*, 25: 662 (May) 1933.
9. Drosin, L. Observations on the mechanism and signs of separation of the placenta. *Surg. Gynec. Obst.*, 56: 40, 1933.

THE USE OF SOLUTION OF DIAL WITH URETHANE IN OBSTETRICS

EMMET H. RUND, M.D.

ST. LOUIS, MO.

SINCE the pioneer work of Channing in this country and of Simpson abroad, obstetricians have striven constantly to improve methods used in the attempt to secure painless labor. Chloroform, ether, nitrous oxide-oxygen, and ethylene are, without doubt, of value, but all of these volatile anesthetics require more or less constant supervision in their administration and, in dosage sufficient to bring about true analgesia, interfere with the progress of labor and are not free from undesirable side-effects. Non-volatile anesthetics are decidedly more convenient, and among these, various barbiturates have been utilized as obstetrical analgesics. With most of these I have had some experience, but as a general rule my own results, together with reports from other obstetricians, have led me to the conclusion that the undesirable features of these drugs outweigh the advantages they possess. To this general rule, the solution of dial with urethane constitutes, in my opinion, an exception, and, from results so far obtained, would seem to deserve a more thorough trial as an obstetrical analgesic.

Dial is diallyl-barbituric acid, and, in the form of tablets has been used to a limited extent abroad in the effort to secure obstetrical analgesia. Hussy[1] administered dial in combination with dionine, reporting favorably, which seems remarkable in view of the small doses used. Baumann[2] likewise was able to confirm Hussy's findings and Krafft and Rossier[3] also observed definite amelioration of labor pains and frequent amnesia following small oral doses of dial with dionine or heroine.

Dial, like most similar compounds, is practically insoluble in water. A mixture of dial with urethane and mono-ethyl urea, however, is water-soluble, the commercial preparation, available in 2 c.c. size ampules, containing 10 per cent dial and 40 per cent urethane, together with the relatively inert mono-ethyl urea. One should not lose sight of the fact that the urethane, added primarily to bring about solution in water, undoubtedly contributes to the action of the preparation and may be partly responsible for its superiority over other barbiturates that have been tried in obstetrics.

The first observers to employ the dial-urethane solution in obstetrics were McNeile and Vruwink.[4] These authors substituted the solution for morphine-magnesium sulphate in the Gwathmey ether-oil method, injecting 2 c.c. intramuscularly when the cervix is dilated from two to three fingers. They received the impression that the preparation brings about an increase in the strength of uterine contractions and a hastening of cervical relaxation. Lynch[5] used solution of dial with urethane in a similar manner as a morphine substitute in the Gwathmey method.

Garcia,[6] of Madrid, used the solution of dial with urethane by intravenous injection in a series of 11 cases. His dosage seems to have been rather heroic in some instances, amounting to as much as 7.5 c.c., but he noted no untoward results that could be ascribed to the drugs and concludes that the preparation is distinctly useful as an obstetrical analgesic. Nelson,[7] also, administered the solution intravenously, employing an initial dose

of 2 c.c., repeating this once, twice, or, in exceptional instances, three times during the course of labor. From his observations in 110 cases, he concluded that the dial-urethane solution was a safe and effective obstetrical analgesic, increasing the strength of uterine contractions and hastening relaxation of cervix and perineum.

Commencing two years ago, the solution of dial with urethane was used routinely in the Obstetrical Department of St. Anthony's Hospital, the contents of a 2 c.c. size ampule being injected deeply into the muscle when cervical dilation had reached about two fingers. No detailed records were kept, but the general impression I gained was so favorable that it was decided to carry out a more careful study at the St. Louis City Hospital, which has been possible through the assistance and cooperation of Dr. D. B. Elrod, Senior Obstetrical Interne, and his associates. A preliminary report, based on 50 cases, was made in May, 1933; the present paper is based on a series of 115 consecutive cases in which the preparation has been employed.

DOSAGE

It is quite obvious from the review of the work done by others that the dosage of dial-urethane solution has varied widely. At the outset of the present study, 2 c.c. were injected intramuscularly as early in labor as possible, and a second similar dose was given thirty to forty-five minutes before expected delivery. In a certain proportion of our cases, the patient arrived at the hospital with labor far advanced, and, as shown in the tabulation, only one dose of 2 c.c. was injected in such instances. The effects develop rather slowly after intramuscular injection; consequently, as our study progressed, intravenous injection of from 2 to 4 c.c. was employed when a rapid action was desired. Later on, we came to adopt, as routine, the intramuscular injection of 2 c.c. early in labor, to be followed by intravenous injection of a similar volume from ten to thirty minutes before delivery. This method has been found most satisfactory, the intramuscular administration producing effects somewhat slowly but prolonged in nature; the intravenous injection abruptly suppressing sensitivity for a relatively short time. The impression has been gained, however, that administration of large doses of the solution before the pains are well established retards labor. Although this is at variance with the opinions expressed by McNeile and Vruwink[4] and Nelson[7] I have come to feel that dial-urethane should not be administered in large doses until labor pains are occurring every three or four minutes and at least a two-finger cervical dilation is present. Even under such conditions as this, there may be a temporary retardation of labor following intravenous injection of 2 c.c. or more of the solution, but this retardation soon passes off.

NUMBER AND TYPE OF PATIENTS

There were 115 cases (unselected), classified as follows:

Para i	77
Para ii	18
Para iii	10
Para iv	7
Para v–vi	3
Total	115

Of these 115 patients, 42 received but a single injection of 2 c.c. of the dial-urethane solution; 64 were given 4 c.c.; 8 received 6 c.c. and 1 received a total of 8 c.c. The average duration of labor was as follows:

First Stage	Second Stage	Third Stage	Total Average
Primiparae 14 hr. 9 min.	1 hr. 7 min.	16 min.	15 hr. 32 min.
Multiparae 9 hr. 20 min.	40 min.	22 min.	10 hr. 22 min.

The shortest labor in a primipara was 7 hours and 9 minutes; the longest, 36

hours and 19 minutes. The shortest labor in a multipara was 3 hours and 20 minutes; the longest (hydrocephalic infant, necessitating craniotomy) 18 hours.

The time between injections varied from one to eight hours. In the first series of 50 cases (preliminary report read May, 1933) all patients were given deep intramuscular injections, except 10 patients who at some time during labor received dial-urethane intravenously in dosage of 2 to 4 c.c. The average case can be carried on 4 c.c. of dial-urethane, but occasionally 6 c.c. are necessary.

EFFECT ON INFANT

In the series there were:

1—Hydrocephalic; spina-bifida
1—Stillborn
1—Blue baby (acted as twilight baby)
2—Given alpha-lobeline. Poor breathers
110—Spontaneous cry and respiration.

However, our impression is that the same number of complications are encountered in cases without any form of medication. The three babies with poor respiration had considerable mucus in the throat.

PLACENTA

The placenta was expressed intact from three to twenty minutes following the second stage. Only one case of postpartum hemorrhage, which was moderate and stopped by 1 c.c. of pituitrin intravenously, was encountered.

REACTION OF PATIENT DURING LABOR AND MEMORY OF EVENTS

Of this series of cases, the average patient was of normal mentality, cooperative throughout her entire course of labor. There were six uncooperative patients, who were noisy and excitable from the beginning to the finish of labor. However, their memory was vague. In 22 cases repair was carried out, but the patients were unaware that suturing was taking place.

Thirty patients had first degree tear; 7 had second degree tear. There were 9 cases of episiotomy and forceps delivery. These patients were given a few whiffs of chloroform for episiotomy and forceps application. Repairs were made without anesthesia and without any pain to the patient. Twenty-one patients were given light chloroform anesthesia for Ritgen maneuver. This anesthesia was not necessary, as the patients were cooperative, having little pain, but it was given to relax the perineum and to have complete control over the head, as it was lifted out by this maneuver.

Out of the first series of cases only three received no apparent effects from the dial-urethane. In case No. 2436 (para i) 2 c.c. were given at 6:40 A.M.; delivered at 7:23 A.M.; case No. 1218 (para iii) dial-urethane 8:00 A.M., 9:00 A.M., delivered 9:15 A.M.; case No. 2150 (para ii) dial-urethane 5:00 P.M., delivered twins at 6:15 P.M. and 6:27 P.M. In these cases dial-urethane was given intramuscularly, the reason for lack of effect being that the injection was insufficient or too late in the course of labor.

The following cases were especially striking:

Case I. No. 4648. Age twenty-one (para v) admitted in active labor and having convulsions. B.P. 170/90, urine 4+ albumin. Given initial intramuscular injection dial-urethane at 8:30 P.M. Convulsions continued, but were lighter, two light convulsions lasting a minute between time of admission and delivery. She was also given at time of admission 1000 c.c. 10 per cent glucose. At 10:25 P.M. patient was put on delivery table and given 2 c.c. dial-urethane intravenously. Patient able to answer questions following administration of drugs, but did not remember any details of delivery.

Case II. No. 5081. Age seventeen (para i) admitted in labor complicated by congenital pulmonic stenosis. She was given three injections of dial-urethane; the first two were given intramuscularly at 10:15 A.M., 12:30 P.M. and the last intravenously at 6:10 P.M. A local anesthesia of 1 per cent novocaine followed by

episiotomy and forceps delivery of 8 pound male baby at 6:20 P.M. Patient had only faint memory of events throughout delivery.

The average reaction of the patients during pains was either a slight restlessness, or a low cry or grunt; some sleep was obtained between pains. In this interval of rest between pains they assumed a quiet attitude and answered any questions put to them, and were always willing to cooperate by moving from the bed to the stretcher and changing from the stretcher to the labor table without assistance. During labor patients often had no idea of what was going on, and occasionally inquired as to what was being done. Repair of tears and episiotomy repairs were done without additional anesthesia, during which time the patients remained quiet and suffered no apparent pain.

Questioned later, some thought they had considerable pain, but in many cases of this character, they showed no facial expression of pain during labor and several of these had episiotomy repairs and were quiet on the table during this procedure.

We were able to produce complete amnesia during the second and third stages of labor in 3 cases by a larger dose of dial-urethane, in which 6 to 8 c.c. were injected within a period of six to eight hours. These patients were quite groggy for twelve hours following delivery, and two complained of double vision during this time.

No increase of injuries to the birth canal as noted in our series of cases.

CONCLUSIONS

1. Solution of dial with urethane can be given with comparative safety in graded doses from 2 to 6 c.c. without any apparent deleterious effect upon the baby.

2. A dose of 2 c.c. injected when labor is well established and a second similar dose about ten to thirty minutes before termination produces a marked amelioration of labor pains; however, many cases need further medication to produce desired results. No set rule as to dosage can be employed, and each case must be governed accordingly.

3. It is possible to carry a patient through delivery on dial-urethane in the state of practical oblivion, but after-effects last too long (twelve hours).

4. Temporary double vision in 2 cases was the only complication noted, and in these cases a large dosage was given.

5. This preparation does not depress the respiratory center of the newborn. It does not lead or predispose to post-partum hemorrhage in the mother. Given at the proper time, it does not retard labor, but rather hastens it. It alleviates pain and produces relaxation of the cervix and perineum.

6. It is possible to do episiotomies and make repairs without aid of any additional anesthetic and without pain to the mother.

7. The preparation does not produce excitement, but acts as a sedative; therefore, the patient rests and sleeps between pains during actual labor and immediately falls to sleep at the conclusion of labor.

8. The use of solution of dial with urethane is simple, safe, and there are no contraindications for its use, but it should never be injected subcutaneously.

9. I realize that the small number of cases reported herewith is insufficient to make positive claims, but the results so far obtained are gratifying enough to continue further studies in the use of this drug.

REFERENCES

1. Hussy. *Zentralbl. f. Gynaek.*, No. 21, 1916.
2. Krafft. These de Lausanne, 1917.
3. Krafft and Rossier. *Schweiz. med. Wchnschr.*, No. 11, 1921.
4. McNeile and Vruwink. *Calif. & Western Med.*, 26: 640 (May) 1927.
5. Lynch. *Calif. & Western Med.*, 29: 173 (Sept.) 1928.
6. Garcia. *Rev. med. Gallega*, Vol. 8, 1928.
7. Nelson, J. *Florida M. A.* (Aug.) 1932.

PREVENTION OF NECROSIS IN

PLASTIC REPAIR OF THE BREAST

JACQUES W. MALINIAK, M.D.

NEW YORK CITY

WIDER recourse to plastic repair of the deformed breast will depend to a great extent on the safety of the procedures employed and the percentage of satisfactory postoperative end-results. The surgical technique must rest on a sound anatomic, physiologic and artistic basis; for the problem is not limited to reduction of the size of the breast without complications but includes the establishment of aesthetic proportions, form and symmetry. Other factors to be considered are the degree of change in postoperative function, if any, the permanence of the result, the distant prognosis and any influence which the removal of fatty and glandular tissue from the breast may exert upon the organism as a whole.

Elsewhere the writer has evaluated from the cosmetic viewpoint the different surgical procedures employed.[1] Here we wish to stress one of the major angles in plastic repair of the breasts; namely, the problem of blood supply and postoperative necrosis.

Partial necrosis of skin or nipple may occur in this type of surgery unless suitable precautions are taken. The possibilities of its occurrence must be entirely eliminated for any reparative procedure to be acceptable. This complication can almost always be avoided in the light of present-day knowledge. The prevention of postoperative necrosis largely depends on preservation of the blood supply. To this end a clear understanding of the vascularization of the breast is essential.

MAMMARY BLOOD SUPPLY

The blood supply of the gland is provided by several independent sources (Fig. 1). Among the most important of these is the thoracic lateral artery (branch of the axillary artery), which supplies the serratus anterior muscle and also sends perforant branches (external mammary) through the major pectoral muscle to the gland proper and the external skin.

Equally significant from the point of view of blood supply is the internal mammary artery, located about 2 cm. laterally from the border of the sternum, directly under the costal cartilages. This vessel sends seven perforant branches to the first seven intercostal spaces toward the pectoral muscle, the deeper portion of the gland and the skin on the inner third of the breast. The branch artery which passes through the second intercostal space is of particular importance, both for its size and because it supplies the gland directly.

Of lesser import are those branches which derive from the intercostal arteries, pass through the thoracic muscle and ramify into smaller branches on the posterior aspect of the gland. It should be noted that there is practically no anastomosis between these various sources of blood supply; hence the necessity for their preservation. It is of additional significance that the blood supply of the areola and the nipple derives from vessels coming from behind. Therefore the superficial circular skin incision around the areola, which is employed in various procedures, does not in any way endanger the vitality of the part. This anatomical fact, which has had extensive clinical confirmation, removes the grounds for certain complicated procedures which are based mainly on the assumption that the circular incision

interferes with the blood supply of the nipple. The methods of Joseph[2] and Schwarzman,[3] among others, fall in this group.

PRECAUTIONS FOR THE PRESERVATION OF BLOOD SUPPLY

On the strength of the anatomical foundation, the following precautions are recommended for the preservation of the blood supply.

1. Special care should be taken to avoid interference with the blood supply during the excision of excessive fat and glandular tissue from the sides of the breast. When large quantities of such tissue must be sacrificed and the main blood vessels tied off, particularly in the external quadrant of the breast, the repair should be done in two stages for the sake of safety; i.e., the excision of excessive tissue and the fine modeling of the reconstructed breast are done after complete healing of the transposed areola has taken place.

2. The excision of fat and glandular tissue at the lower pole of the breast is safely done during the first stage. In undermining the anterior flap or excising fatty tissue from the upper pole special attention must be given to the second intercostal space so as not to injure the corresponding intercostal artery, which is of large caliber and supplies the glandular structures.

3. In modeling the lower pole of the breast, care should be taken not to excise too close to the nipple or the posterior aspect of the gland, where there is danger of interfering with the pedicle of the breast.

4. The anterior skin flap should include adequate subcutaneous tissue, particularly in the segment between the newly placed areola and the submammary fold. Vessels of larger caliber that are perceptible during the dissection should be preserved wherever possible.

5. Because of its tendency toward necrosis, poorly vascularized fat tissue must be treated with caution; extensive trauma leads to liquefaction and infection.

The anatomical considerations just described disqualify procedures based on extensive resection of the breast structures,

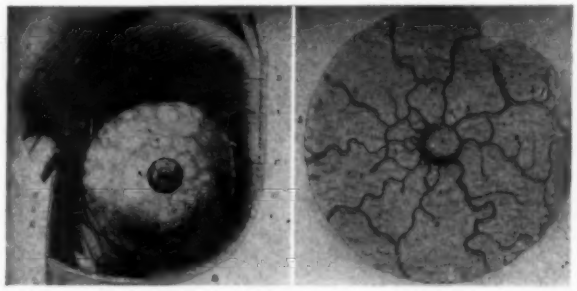


Fig. 1A. Fig. 1B.

Fig. 1. A. Blood supply of breast. (Testut.) Thoracic lateral (3) branch of axillary (6) supplying external half of breast. Internal mammary (1) with perforant branches to intercostal spaces providing deeper portion of gland and skin of inner third of breast. B. Periareolar and subareolar vascular plexus superficially situated under skin. This plexus must be thoroughly preserved during undermining of skin in central portion of breast. 1, Nipple. 2, Posterior surface of areola.

especially in the external quadrant (Fig. 2). They also argue against those methods in which the resection is carried out in the neighborhood of the posterior aspect of the breast and the pedicle.[4,5]

PROCEDURE

The procedure of choice, which we have described elsewhere[6] consists of subcutaneous transposition of the central portion of the gland and proportionate reduction of the size of the breast, the whole carried out with full consideration for the main sources of blood supply. Let us consider these two steps in their logical order.

Transposition of the central portion of the gland can be accomplished safely only when there is no interference with the main blood supply. If a wide excision of superfluous glandular and fatty tissue is made at the same time, there is necessarily a degree of interference with the vascular system. This danger is obviated by proceeding in two stages: the transposition of the central portion of the gland is done in the first and the final excision of excessive glandular and fat structures in the second.[1] (Fig. 4.)

The two-stage operation not only eliminates all danger of necrosis from insufficient vascularization but also makes possible a better cosmetic end-result, since the final modeling is done without haste during the second stage, under a local anesthesia. The shortening of the operation, by its division into two parts, considerably lessens the operative shock. A complete plastic repair of both breasts, done by a skilful surgeon, requires an average of one and one-half to two hours for its completion. Since this surgery is usually done under a general anesthesia, it is natural that the fine details of remodeling are sidetracked for the sake of speed. As a result, secondary correction is frequently necessary to secure an acceptable contour. The two-stage method permits the final modeling to be done without haste.

FIG. 2A. FIG. 2B.

While interference with the blood supply is the direct and most frequent source of postoperative necrosis in plastic repair of the breast, there are several errors in surgical technique which may indirectly cause this complication. Chief among these are *undue tension* and *torsion of the transposed part.*

AVOIDANCE OF UNDUE TENSION

The first consideration in the avoidance of undue tension is proper fixation of the nipple into the resected window. Once the fine areolar skin is freed from its connection, it naturally contracts to a great extent. The skin defect prepared to receive it, on the other hand, stretches

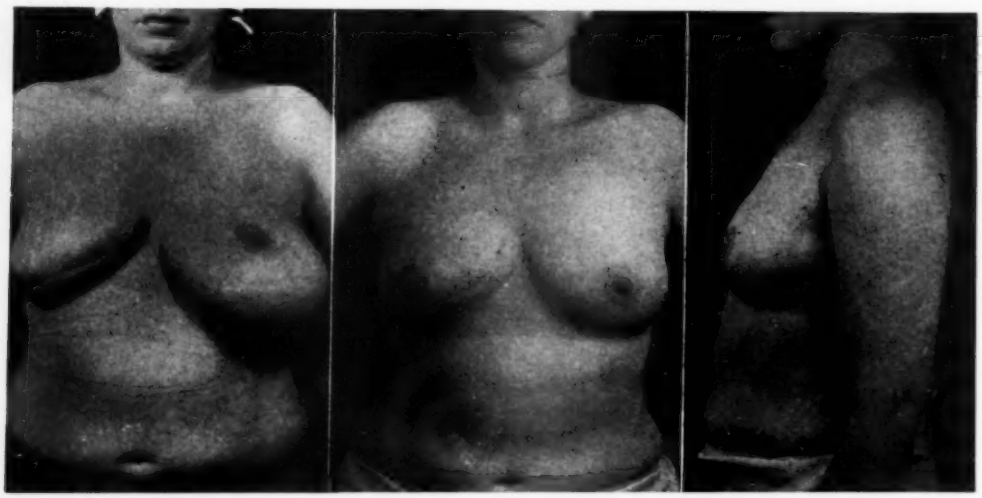


FIG. 2C. FIG. 2D. FIG. 2E.

FIG. 2. Girl aged twenty-two, showing condition of right breast a few months after a one-stage plastic operation done elsewhere for a hypertrophic breast. Right breast had been similar to left shown here. Nipple and greater portion of breast sloughed away and resulting raw surface was approximated, leaving scar as shown in A. C. Condition of left breast six weeks after first stage plastic repair. Note inconspicuousness of scar around reduced areola which was transposed to a higher position. Extent of reduction in size of breast can be judged by comparing with condition shown in A. D, E. Condition following second stage of plastic repair after excision of all redundant skin, fat and glandular tissue in lower and external quadrants. Main incision is placed in submammary fold. Irregular flat scar on right breast was excised and subcutaneous tissue slightly adjusted to match left breast. A new nipple and areola were tattooed.

because of the normal elasticity of the skin. To avoid excessive tension on the transposed nipple and areola, it is necessary to fix the proportions of the parts involved very carefully. As a rule, it may be stated that the new implacement of the nipple should be from 2 to 3 mm. less in diameter than the areola, thereby allowing for the shrinkage of the latter and the elasticity of the skin surrounding the former.

When the transposed areola is sutured under undue tension and the skin is stretched in all directions, the blood supply of the area may be endangered. This is observable at the time of operation: the areola and nipple become dark blue and do not regain their normal color. When this happens the tension must be relieved at once if necrosis of the nipple is to be avoided. One cannot expect restoration of the circulation by any other means. It is always preferable to make

Fig. 3A. Fig. 3B. Fig. 3C. Fig. 3D.

Fig. 3. A. B Girl aged twenty-three showing asymmetrical hypertrophic and pendulous breasts. Although both breasts had been oversized since early adolescence, rapid growth of both started at the age of twenty-two. Pathological examination of glandular tissue revealed multiple cystic fibromas, particularly numerous and large on left side. C, D. A two-stage procedure was used on left breast. Because of its notably smaller size right breast was repaired in one stage. Due to excessive tension which resulted after excision of skin on posterior aspect of breast and placing of suture line in submammary fold a partial superficial sloughing of right areola occurred. Fortunately this did not interfere with final outcome of repair. Resulting scar of areola was tattooed.

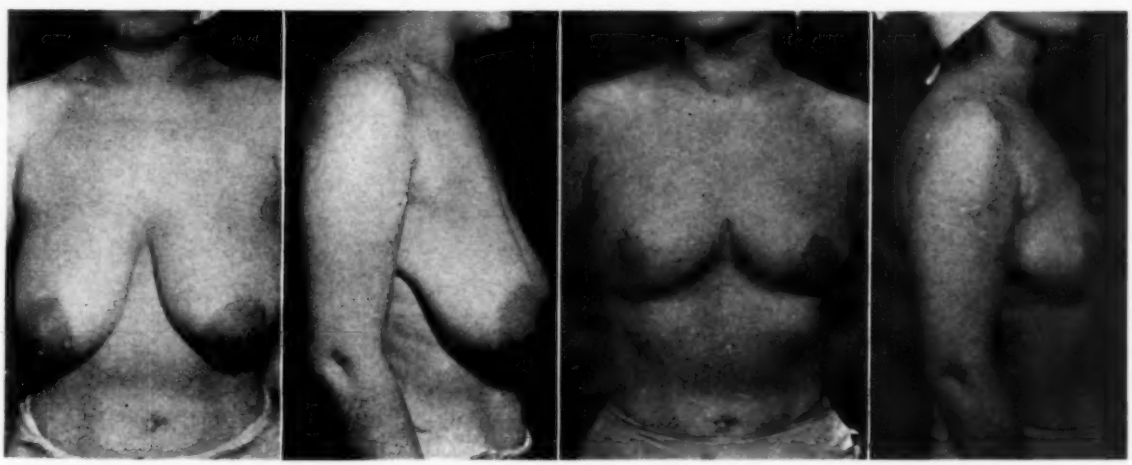


Fig. 4A. Fig. 4B. Fig. 4C. Fig. 4D.

Fig. 4. Woman aged twenty-eight, married, showing hypertrophic and pendulous breast which interfered with her profession as a pianist. Repair was done by two-stage procedure. A, B. Before repair. C, D. Photographs showing final result were taken a few weeks following second stage, thus explaining visibility of scars which usually fade out in course of a few months.

the areola larger in diameter than is usually required and then make the necessary adjustment prior to suturing.

The shape of the skin window is also an important factor as it determines the future configuration of the areola. When the individual is upright, the weight of the breast tends to elongate a circular incision. In a dorsal position the weight tends to the sides and there elongates the pigmented circle outward. It is necessary to make the window elliptical to maintain the circular configuration of the areola.

The danger of undue tension presents itself also when the newly outlined areola and the skin opening do not correspond to each other, the opening being either too much to one side or too high. Attempts to force the transposed part into position to compensate for this error result in excessive tension with all its attendant dangers. This technical error can be avoided by outlining the skin excision at the proper level prior to operation, taking into consideration the future size of the breast and the position of the nipples.

PREVENTION OF TORSION

Another reason for partial sloughing of the areola or surrounding skin is torsion of the pedicle. This can easily be produced without the surgeon's knowledge when the breast is transposed upwards after extensive undermining of the skin: the landmarks are lost when the anterior flap is separated and the entire gland is rotated as the breast is transposed upward, with the result that the lower border of the areola may be sutured laterally, producing a more or less pronounced torsion of the part. There is also a corresponding torsion of the gland and pedicle, with derangement of the blood supply. This complication can be avoided by marking the upper pole of the areola with a suture before undermining of the anterior flap is begun.

SKIN NECROSIS

It is self-evident that the skin of the breast must be meticulously preserved. Necrotic areas of greater or lesser extent are followed by scar formation, which necessarily detracts from the cosmetic end-result. The safety of the skin can be assured by respecting the following considerations.

During the flap dissection strict attention must be paid to the preservation of the vascular plexus located in the subcutaneous fat (Fig. 1 B). The skin flap must be of fair thickness, especially in that portion located between the window and the submammary fold. Large subcutaneous vessels should be left intact wherever possible.

Circumscribed superficial necrotic areas frequently occur at the distal end of the flap, in spite of the utmost care, when the repair is done in one stage (Fig. 3). Dark blue patches of varying extent appear along the free border of the flap, especially in the narrow cutaneous bridge between the nipple and the submammary fold. These are warnings of interference with the blood supply and are usually followed by sloughing. The skin between the two suture lines is often under great tension. The narrower the bridge, the greater the risk of impoverishing the blood supply. Hence the possibility of necrosis. The two-stage procedure prevents this.

The shape of the breast should be outlined by the subcutaneous structures and not by an excessively stretched skin. The latter is entirely unsuitable for the maintenance of the mammary contour; under moderate weight or pressure it may give way. The skin should provide an evenly distributed covering for the reconstructed breast; under no circumstances should it be submitted to excessive pressure.

These factors should be borne in mind when measurements for outlining the skin flap are made. It is always safer to make

the flap slightly larger than necessary and then diminish its size after final reduction of the gland. For the purpose of avoiding a narrow skin bridge between the newly located areola and the submammary fold, it is advisable to perform the window resection after final modeling of the gland.

Hematoma is another bugbear which may endanger the continuity of the skin by producing tension. The most painstaking hematosis must be maintained: rubber drains should be inserted along the suture line for the first twenty-four hours. This provides for the evacuation not only of blood serum but also of liquefied fat.

To minimize scarring around the nipple and the submammary fold, exact approximation of surfaces of equal length is necessary. To accomplish this, triangular skin excisions must sometimes be made from the longer surface. The use of fine paraffinized silk and removal of sutures at the earliest possible date (about seven days) will result in unnoticeable scars. Early *x*-ray therapy applied to the scars at regular intervals will help greatly to minimize conspicuousness when a tendency to hypertrophy becomes evident.

SUMMARY

1. The use of the two-stage method for plastic repair of the breast prevents necrosis by safeguarding the blood supply, especially in the external quadrant, shortens the time required for surgery under general anesthesia and permits the final remodeling to be done without haste under local anesthesia.

2. Proper fixation of the nipple into the resected window is essential to prevent necrosis from excessive tension.

3. To prevent torsion, an indirect cause of partial necrosis, the landmarks should be marked before undermining of the anterior flap is begun; otherwise the gland may be rotated as the breast is transposed upward and the lower border of the areola may be sutured laterally.

4. Skin necrosis can be prevented by preserving the vascular plexus in the subcutaneous fat during flap dissection and by avoiding tension on the cutaneous bridge between the nipple and the submammary fold.

REFERENCES

1. Maliniak, J. W. Pendulous breast. Etiological factors and surgical treatment. *Congr. de la Soc. franc. de chir. repar.* Paris, Maloine, October, 1931.
2. Joseph: Zur Operation der hypertrophischen Hangebrust. *Deutsche Med. Wchnschr.*, Nr. 27, 1925.
3. Schwarzman, E.: Die Technik der Mammaplastic "Der Chirurg." Wien, Springer, 1930. 2 Jahrg. Heft 20.
4. Biesenberger. Eine neue Methode der Mammaplastik. *Zentralbl. f. Chir.* Nr. 48, 1930.
5. DeQuervain. Zur operativen Behandlung der Hangebrust. *Ber. d.* XII *Jahresversamml. d. Schweiz. Gesellsch. f. Chir. Zentralbl. Chir.*, 1925.
6. Maliniak, J. W. Asymmetrical breast deformities. *Ann. Surg.*, (May) 1934.

A METHOD TO AVOID

SKIN GRAFTING IN BREAST AMPUTATIONS

J. F. BALDWIN, M.D.

COLUMBUS, OHIO

MORE than a quarter of a century ago the present radical "dinner-plate" amputation of the cancerous breast came into vogue with its instant improvement in curative results; the annoying feature of the operation, however, is the occasional necessity of removing such a large area that it is impossible to close the wound completely. Hence, during all these years there has been the occasional resort to skin grafting, either at the time of the operation or a little later. This necessity led to the humorous suggestion by a brilliant surgeon that the one who is to make the incision should not be the one who is to close it, since dread of attempting the closure might make him remove less than the proper amount of suspicious tissue.

I remember very distinctly the time, more than thirty years ago, when this problem was first presented to me. I had never fancied the idea of skin grafting, although I had several times been obliged to resort to it in other conditions, but when the necessity arose in this case it appeared at once that the natural way of overcoming the difficulty was to undermine the other breast and by suitable incisions secure a flap which could be pulled over and thus cover the surface with a minimum of tension and deformity. The idea was at once carried out and was entirely successful. I soon noticed that in an occasional case one or both of the corners of the flap lacked a sufficient blood supply and sloughed; the sloughing areas were small and promptly healed, but it increased somewhat the annoyance. I therefore cut off the two corners, sometimes cutting straight across, sometimes rounding the edge, and thus had a sufficient blood supply and no trouble. I have resorted to this method many times, and have frequently demonstrated it to visiting surgeons. The maneuver seemed so simple that I had supposed it was in general use until a few months ago when, in connection with some correspondence with eastern surgeons, I found it apparently had never been resorted to; and then on looking through a number of text-books on surgery I failed to find it mentioned.

In brief detail; the removal of the breast, underlying muscles, axillary glands, etc., is carried out by the usual method. If the cancerous tissue is so limited that the surgeon can make a safe and thorough removal, and still leave sufficient tissue, the wound is then closed in the ordinary way; but if, as is not infrequently the case when the work is done thoroughly, the edges of the wound cannot be approximated, two transverse incisions are made directly outward from the open wound, the upper one parallel with the clavicle and the other at a suitable point below. These incisions are extended as necessary and the flap detached from the chest by free dissection from the chest muscles. A few little bleeders are caught and tied, but the remaining blood supply has always been ample. The distance to which the flap shall be separated must depend entirely on the necessity of the case. A sufficient piece of each of the two corners is removed, the entire flap then pulled over the exposed surface and attached by interrupted sutures, usually of silkworm gut, to the opposite edge of the wound, with approximation of the skin between these sutures by continuous chromicized catgut No. 2.

If necessary, as it generally is, a button hole is made through which are withdrawn one or two cigaret drains, to be removed in a few hours. A snug bandage is then applied around the entire chest and the operation is complete. Healing occurs promptly, and with a minimum of tension. I have never had a complaint on account of the change in position of the breast. It is possible that occasionally the breast might be so large as to result in a deformity, but in such a case it would be perfectly feasible to resect the gland in whole or in part as the surgeon's judgment might indicate.

SUMMARY

The large area removed in breast amputations sometimes makes it impossible to close the wound completely, so that occasionally skin grafting has been resorted to, either at the time of operation or later.

To avoid this, I have devised a method of securing a flap from the other breast, at the time of the amputation, to cover the surface. The technique of the procedure is described.

NORMAL SHADOW OF THE PERIPHERAL NERVES AND THEIR PATHOLOGICAL CHANGE IN INJURY AND TUMOR

ROENTGENOLOGICAL STUDIES BY MEANS OF THORIUM DIOXIDE SOLUTION (THOROTRAST)

PROF. DR. MAKOTO SAITO

NAGOYA, JAPAN

PREFACE AND LITERATURE

IN our cooperative study, Kamikawa, Kato and I[1,8] have successfully carried out the roentgenological visualization of the peripheral nerves by means of an emulsion of lipiodol (*l'ombre*[2-7]), which was formerly used by us as the opaque substance for blood-vessel visualization. The opaque substance was injected endoneurally or intraneurally, and thus the peripheral nerves were visualized for a distance of 10–17 cm. of their length. The emulsion of lipiodol injected into the nerve infiltrates into the nerve fibers, and enables us roentgenologically to visualize the shadows of nerve. Therefore, this method can not only be called neurography, but may also be entitled neurohistography. We have also visualized the brachial and lumbosacral plexuses by the interneural or perineural injection method. Moreover, by means of neurography of the lumbosacral plexus with our preparations, which ascend along the epidural space, extradural or epidural myelography is possible, while neuroradiography is also possible.

I again tried neurography by means of injecting thorium dioxide solution (thorotrast).[9] This preparation was obtained from the Heyden Company in Germany, and also in Japan from the Radium Pharmaceutical Company for the same preparation, which was offered to me for the trial under the title of "trisol" or "triombre." This proved to be an excellent medium for arteriography and neurography. In my surgical clinic Fujimoto, Kamikawa, and Tashiro[10,12] injected thorotrast into the abdominal cavity of dogs and rabbits, and found that the medium, being absorbed into the lymph vessel, was quite effective for taking radiograms, making clearly visible the diaphragmatic lymph vessel, retrosternal lymph vessel, and the retrosternal lymph glands. Nakashima[11] in my surgical clinic also injected thorotrast into the cavity of the human knee joint, and found that the substance being absorbed into the lymph vessel made possible the visualization of the lymph vessel in the thigh, and the femoral lymph glands as well as the lumbar lymph gland were also distinctly revealed. Thus we have also proved the possibility of lymphvasculography by means of injecting this medium, that is to say that lymphvasculography or lymphangiography and lymphglandulography or lymphadenography are practicable. This medium gives no disturbance locally in the human body. Nakamura[13] also reported its diagnostic value after applying this method in a case of injury to the peripheral nerve. By injecting thorotrast I visualized N. ulnaris which is the only nerve easily reached percutaneously from the outside of the human body.

TECHNIQUE OF NEUROGRAPHY OF N. ULNARIS AND ROENTGENOLOGICAL SHADOW OF THE NERVE

By the endoneural or the intraneural injection method of thorium dioxide solution I carried out subcutaneous injection into the ulnar nerve. As the locality for

the injection I selected sulcus n. ulnaris of the humeral bone. The arm is extended from the elbow, the nerve is located at the sulcus n. ulnaris by the left index finger, and punctured percutaneously with a thin needle. When this is done, the nerve will naturally be fixed, which will no longer move under the index finger. Then 0.5–1.0 cc. of thorium dioxide solution can be injected slowly into the ulnar nerve. It is advisable to take neurographs twenty-four hours, two days, and three days from the time of injection, because after the injection, as time goes on, thorium dioxide solution, like the emulsion of lipiodol, will flow towards the center. Therefore, it enables us to visualize a part distant from the injected point. I have visualized the normal ulnar nerve of patients in the following 7 cases (Table 1):

Table 1

No.	*Name of Patient*	*Sex*	*Age*	*Clinical Diagnosis*
1	D.	M	23	Contusion of left foot.
2	B.	M	27	Compound fracture of left leg.
3	G.	M	20	Chronic ulcer of left leg.
4	M.	F	11	Cicatrized contracture of right hand.
5	I.	M	12	Osteomyelitis of left tibia.
6	K.	F	11	Congenital syphilis with gonitis duplex syphilitica.
7	O.	F	23	Anemia after hemorrhoidal hemorrhage.

Case 1. D., male, aged twenty-three years, contusion of left foot.

Soon after the injection of 0.5 c.c. of thorotrast into N. ulnaris on both sides, the nerve was projected as far as 7 cm. on both sides, and the fibrous structure of the nerve was clearly visualized. After twenty-four hours from the time of injection the radiograph of the nerve on the right side showed for a distance of 8 cm. toward the center from the injected point, and peripherally the shadow of the nerve was also visualized for 4 cm. together with a clear shadow of the perineurium. On the left side also the nerve was visualized clearly for 8 cm. towards the central part from the injected point with a clear shadow of the perineurium. Peripherally the shadow of the nerve extended 2.5 cm. from the injected point. Four days after the injection, the shadow

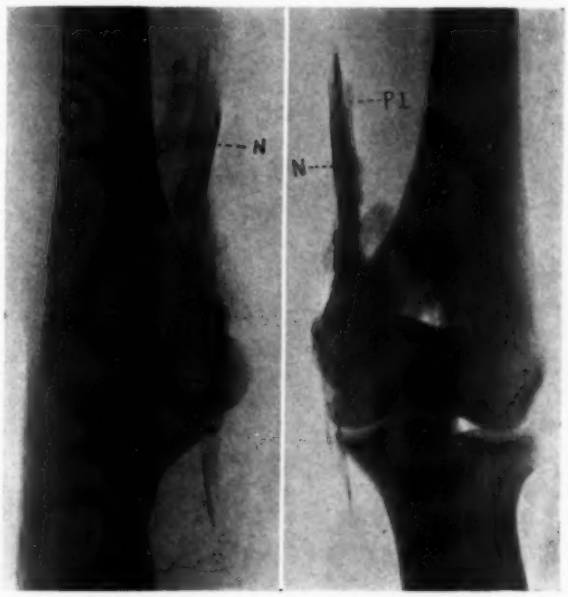


Fig. 1. Fig. 2.

Fig. 1. Case 1. Normal roentgenological shadow of left ulnar nerve (N) one day after injection.

Fig. 2. Case 1. Normal roentgenological shadow of right ulnar nerve. N, ulnar nerve. PI, internal leaf of perineurium.

of the nerve with the perineurium was visualized clearly for 8.5 cm. from the injected point on the left side. The shadow of the nerve was also visualized for 3.0 cm. towards the periphery; and on the right side it was also visible for 9 cm. toward the center from the injected point.

Case 11. B., male, aged seventeen years, compound fracture of left leg.

Twenty-four hours after the injection of 0.5 c.c. of thorotrast into N. ulnaris on both sides, the shadow of the nerve was visualized for more than 15 cm. toward the center from the injected point with a clear outline of the perineurium. On the right side it was visible for 10 cm. toward the center from the point of injection. In this case, a fine shadow of the nerve was also visualized for 5.5 cm. peripherally. On the right side, a cloudy figure around the nerve was observed, which was probably due to the perineural injection of thorotrast. In the radiograph taken three days after the injection, the outline of the ulnar nerve on the left side was visible for 17 cm., starting from a point 4 cm. above the sulcus n. ulnaris of the humerus, and reaching the axillary fossa

of the arm, and we also clearly visualized the shadow of the sulcus of the nerves. There was no change to be especially described after a lapse of four days. On the right side, too, no particular change was observed on the fourth day after the injection.

Fig. 3. Case II. Roentgenological shadow of left ulnar nerve, three days after injection. N, ulnar nerve. PI, internal perineurium.

Case III. G., male, aged twenty years, chronic ulcer of the left leg.

Thorotrast 0.5 c.c. was injected into the ulnar nerve of each side, on the right side by the incision method and on the left by the subcutaneous injection method. Twenty-four hours after the injection the roentgenogram showed on the right side the shadow of the ulnar nerve visible for more than 15 cm. toward the center from the injection point; while toward the periphery it was visible for only 3 cm. On the left side, the shadow of the ulnar nerve was visualized for more than 11 cm. toward the center from the point of injection. The infiltration of thorotrast towards the central part extended out of the film, so it was not projected in the roentgenogram. Towards the periphery, the thorotrast infiltrated adequately and the shadow was visualized for 10 cm. Three days after the injection, the shadow of the ulnar nerve on the right side was visualized for 24 cm. toward the center from the injected point, reaching to the axillary fossa. On the contrary, the shadow was visible for only 4 cm. toward the periphery. Three days later, the shadow of the ulnar nerve on the left side was visualized for 30 cm. toward the center from the injected point, reaching the axillary fossa; while toward the

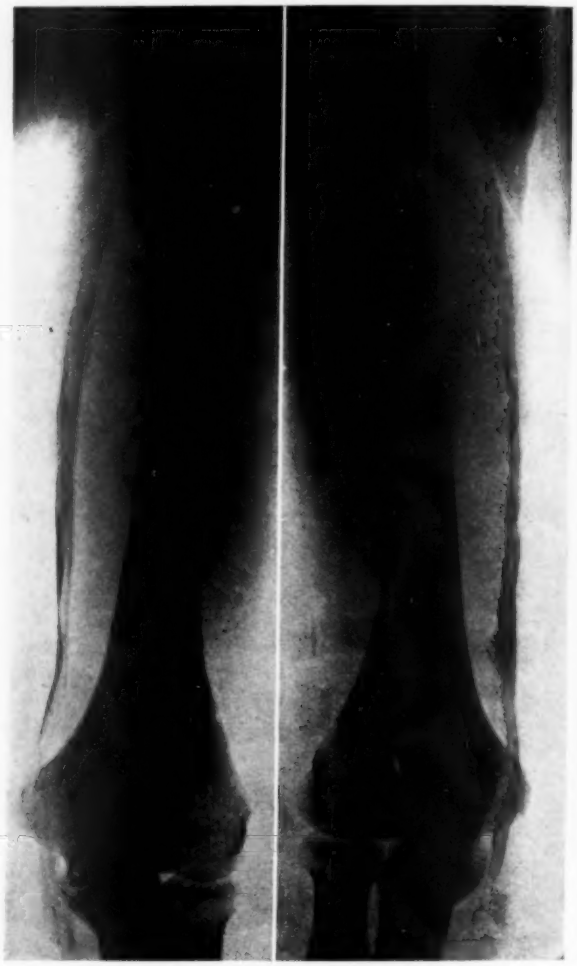


Fig. 4. Fig. 5.

Fig. 4. Case III. Roentgenological shadow of left ulnar nerve three days after injection.

Fig. 5. Case III. Roentgenological shadow of right ulnar nerve four days after injection.

periphery it was visible for more than 5 cm. Four days after the injection no particular change was recognized.

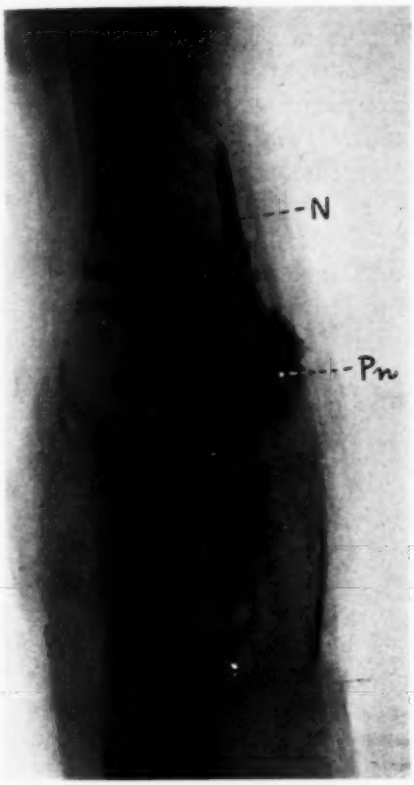


Fig. 6. Case vi. Roentgenological shadow of right ulnar nerve three days after injection. N, ulnar nerve. PN, fat tissue, thorotrast injected.

In the roentgenogram taken five days after the injection, the shadow of the ulnar nerve on the left side was visualized for 24 cm., and reached the axillary fossa. Towards the periphery the figure was visualized for only 4 cm. as it was projected out of the film, but in another film it could be followed for 15 cm.

The shadow of the ulnar nerve in the right side was visualized for 20 cm. towards the center, and for about 4 cm. towards the periphery.

Therefore, in this case the ulnar nerve on the left side was roentgenographed for a total length of 39 cm., from the axillary fossa to a point one-third of the forearm below the elbow. On the right side, a total length of 28 cm. was visualized.

Case iv. M., female, aged eleven years, cicatricial contracture of the right hand.

Injecting 0.5 c.c. of thorotrast into the ulnar nerves on both sides, and taking the roentgenogram on the next day, the result was not favorable. On the right side, the shadow of the nerve was visualized for only

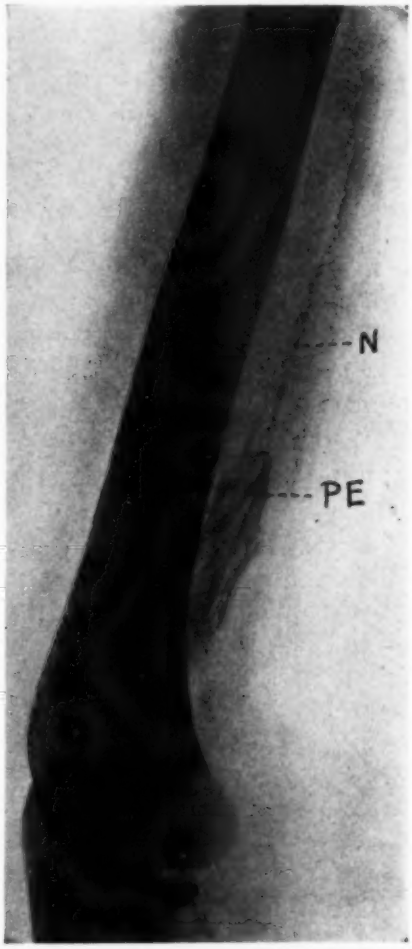


Fig. 7. Case vii. Roentgenological shadow of right ulnar nerve and perineurium. N, ulnar nerve. PE, external perineurium.

7 cm., while on the left side the medium had penetrated into the perineural part.

Case v. I., male, aged twelve years, osteomyelitis of the left tibia.

The roentgenogram was taken after injecting 0.5 c.c. of thorotrast into the ulnar nerves on both sides, but the medium injected into the perineural part revealed the shadow of the nerve only in the shape of white filaments.

Case vi. K., female, aged eleven years, congenital syphilis with gonitis duplex syphilitica.

Thorotrast 0.5 c.c. was injected into the ulnar nerve on the right side. Three days after the injection, when it was roentgenographed I found that the thorotrast, having reached the perineural part, made visible the shadow of fat

tissue, extending for 4.5 cm. from the injection point toward the center, and for 4.5 cm. peripherally. Thus the shadow was visualized for a total length of about 9 cm. By this we can see that this case was a failure.

Case VII. O., female, aged twenty-three years, anemia after hemorrhoidal hemorrhage.

Thorotrast 0.5 c.c. was injected into the ulnar nerve on the right side, and when a roentgenogram was taken three days after the injection, the shadow of the nerve was visible for only 12 cm. from the injected point, forming a figure like a thin cord, which was chiefly due to the infiltration of thorotrast into the perineurium. The perineurium consists of a fiber which runs vertically and a fiber running obliquely, like the twist of a rope. The latter runs on the outside of the former.

In summing up the foregoing results, I found that 0.5 c.c. of thorium dioxide solution injected into the ulnar nerve at the sulcus nervi ulnaris will run towards the center from the point of injection. Kamikawa, Kato and I once injected emulsion of iodide oil, *l'ombre*, into a normal nerve, and found that it also moved toward the center from the injected part. Therefore, we can understand that the lymphatic stream is always running to the center from the periphery.

Spitzer once put some bacteria into the hollow of teeth after the pulpa dentis was removed, and covered the hollow with gum. Inflammation of the alveolar nerve and of the semilunar ganglion was caused. This is due to the fact that the bacterial toxin ran centrally along the nerve as far as the semilunar ganglion, causing the ganglioneuritis. From the study of Spitzer on this subject, it is evident that the absorption of bacterial toxin is proved to flow centrally along the nerve. In my study of neurography by means of injecting thorotrast into the nerve, it is also proved that the thorotrast injected into the nerve morphologically will flow centrally along the nerve. Thorotrast is a metallic colloid prepared from thorium, while the bacterial toxin is albuminous; therefore they are quite identical in nature from the point of view of investigation, and so far as absorption is concerned, both proved the same thing. It was also known, even in old times, that tetanus bacterial toxin was absorbed along the nerve, and so, I believe, a similar result was obtained in my investigation.

In comparing an injection of emulsion of lipiodol (*l'ombre*) and one of thorium dioxide solution, thorotrast, the latter is seen to flow much farther than the former. So the ulnar nerve could be visualized for a maximum of 39 cm. by injecting only 0.5 c.c. of thorotrast into the nerve. Even under ordinary circumstances, if the injection is performed skillfully, the ulnar nerve will be easily visualized for more than 15 cm. The lengths of the ulnar nerves visualized in each of 7 cases are as follows:

Case	*Right Side (Cm.)*	*Left Side (Cm.)*
I	12.0	12.5
II	15.5	17.0
III	28.0	39.0
IV	7.0	
V		
VI	10.0	
VII	12.0	

Of the 7, Cases IV, V and VI were failures. However, from the foregoing results, we know that an injection of thorium dioxide solution can make the nerve visible farther than can an emulsion of lipiodol.

Judging from the roentgenograms of the normal ulnar nerve in the foregoing cases, we can visualize the fibrous structure of the nerve clearly in every case. The shadow of the ulnar nerve is visualized in the shape of a belt 3 mm. wide at the cubital joint, and becoming thinner towards the center until it is visualized as a belt 5 mm. in width. The fibrous figures are arranged in parallel; and at the margin they are observed as a dark lineal shadow (See Fig. 4). The neurographical figures shown in Figures 4 and 5 are the shadows of the left and right nerves of the same patient. In the latter we observe the nerve as a wavy figure, while

in the former it runs in parallel. Again, in Figure 3, we can recognize an irregular denticular shadow around the shadow of the nerve, which is due to the injection of the opaque substance into the neurilemma. In Figures 1, 3, 5, 6 and 7, the perineural figures are clearly visible. In Figure 7 especially, we can recognize both the inside and the outside perineural shadows. The internal leaf of the neurilemma consists of the fibers running in parallel with the nerve, while the external leaf is composed of the fibers running obliquely to the nerve (see Fig. 7). Therefore, we can understand that even when the opaque substance is injected into the nerve perineurography will be possible by means of the opaque substance which leaks out into the sulcus of the nerve.

ABSORPTION OF THORIUM DIOXIDE SOLUTION

In Cases II and III, I examined the absorption of thorium dioxide solution by means of the opaque substance for neurography. On August 20, 1932, they both had the opaque substance injected into the nerve. Forty-five days later, roentgenograms were taken again, and showed almost the same shadows as those which were taken on the third or fourth day following the injection. However, the shadow which was caused by the injection into the perineurium, that is, the perineural shadow, seemed to be absorbed as time went on, while the opaque substance in the nerve might well be described as quite unabsorbable. Comparing this opaque substance with emulsion of lipiodol, when the latter, *l'ombre*, was injected into the nerve it took about a month for the substance to be nearly absorbed. Thus it seems to me that the figure will be removed by the consumption of oil dropped into the tissue and gradually causing oxidation and combustion. On the contrary, as Fujimoto, Kamikawa, and Tashiro[10,11] pointed out in their studies in lymphvasculography, thorium dioxide solution being left in the cell tissue as glanula, is thought to remain there as long as it is not expelled out of the body after coming out of the cell, being dissolved in water by oxidation. The only defect of this opaque substance is that it remains so long in the tissue. Yet, though it remains so long in the nerve, it gives no pain and causes no paralysis of the nerve from the very moment of injection. Therefore, no clinical trouble will result from the substance remaining in the area injected.

FIG. 8. Case III. Roentgenological shadow of right ulnar nerve forty-five days after injection.

ROENTGENOLOGIC SHADOW OF THE NERVE AFTER INJURIES

There is no record concerning the roentgenologic shadow of the peripheral

nerve in cases of injury to the nerve. I carried out neurography in 3 cases of nerve injury as follows:

Case VIII. Paralysis of the ulnar nerve after mobile operation of the cubital joint. T., male, aged eighteen years.

The patient was naturally of good health. However, on October 7, 1931, when he was carrying timber out of the mountain, he was struck by a piece on his left cubital joint, and was unable to move it. He was admitted to the hospital on the same day. On examination, I found that there was no wound to be seen on the skin, but the limb was swollen up in the region of the cubital joint; and movement was entirely impossible, especially that of extension. The roentgenogram of this case showed us fractures of the olecranon and medial epicondyle. The line of fracture of the medial epicondyle continued into the joint, that is to say, it was an intra-articular fracture. In the medial epicondyle two free fragments of bone were also found. On October 23, a suture of the bone was performed for the fracture of the olecranon, with silver wire, under local anesthesia. The wound caused by the operation healed by primary intention, but there was no movement of the joint, and a thickening of the bone occurred on the lower end of the humerus. Three months after the operation, a shadow of bone was visible in the muscle around the cubital joint, indicating traumatic arthritis and traumatic myositis ossificans. Therefore, an operation for articular mobilization was carried out on December 13, 1932.

On opening the skin lengthwise at the flexor side, I found that the whole M. brachialis was tendinously degenerated, being ossified in some parts. It was therefore resected.

After opening the joint, the ulnar nerve was removed, both faces of the joint were made up in the usual way, and wrapped with fascia lata cut from the thigh; then, putting them in reposition, a skin suture was made. In this case I performed Payr's operation of articular mobilization.

The incision wound healed by primary intention but ten days after the operation the patient complained of anesthesia on the skin at the ulnar side of his hand. This was followed by trouble with the movement of his fingers and paralysis of the ulnar nerve.

On May 20, when neurolysis and envelopment with fat tissue were performed, I found that the previous operation for articular mobilization had resulted in some adhesion and the nerve had been wrapped up in the scar. The neurolysis envelopment with fat tissue was carried out because of a thick knotted formation seen in that part of the nerve. The operation was finished by injecting 0.5 c.c. of thorotrast into the peripheral nerve just at the point of the knotty formation. Three months after the operation, the incision wound had healed by primary intention, the movement of the patient's hand was remarkably restored and sensation had been recovered.

In this case roentgeography was carried out on the day of injection (May 20) with the results shown in Figure 9. In this roentgenogram the nerve is finely visualized for 8.5 cm. from the point of adhesion toward the periphery; however, the opaque substance did not flow towards the center through the adhesion. For twenty days after the injection, more than a dozen roentgenograms were taken from time to time, and they also showed that the substance injected into the nerve did not flow towards the center. However, towards the periphery we can follow the shadow of the nerve for 9 cm.

Ninety-three days after the neurolysis, on August 22, 0.5 c.c. of thorotrast were injected into the ulnar nerve cutaneously for purposes of roentgenography, the patient having recovered from the motor paralysis of his hand (Fig. 10).

The nerve was visualized for 10 cm. from the articular space of the cubital joint toward the periphery, and for 16 cm. towards the center, or 26 cm. in all. The perineural shadow was fairly well visualized by the effect of thorotrast which ran into the perineurium, not toward the periphery, but toward the center. Except at the cubital joint, fine shadows of the nerve were visualized toward both periphery and center; however, as is pointed out by arrows in Figure 10, there was a defect in the shadow of the ulnar nerve of the cubital joint. On close examination of the part where there seems to be some

defect we can recognize a light shadow like that of a neuroma. The shadows of the nerve were not alike at the upper and lower parts of the region, appearing very irregular. In addition, we can also see that there was a periosteal thickening of bone (K) at the side of the nerve near the lower end of the humerus. Both faces of the joint showed some irregular forms as the articular mobilization was performed.

Fig. 9. Case VIII. Paralysis of ulnar nerve after operation on cubital joint. N, ulnar nerve. K, adhesion of ulnar nerve on bone by cicatrix. P, perineurium.

In this case, the ulnar nerve, having adhered to that part where the articular mobilization was carried out, caused the paralysis of the ulnar nerve. This paralysis of the ulnar nerve was cured by neurolysis. By the roentgenograms of the ulnar nerve taken before and after the neurolysis, we can clearly visualize the point of the adhesion. The opaque substance injected into the nerve periphery at the adhesion ran only toward the periphery and not to the center through the adhesion. However, after neurolysis the substance injected into the nerve flowed not only toward the periphery but also to the center; moreover, we could recognize the irregular figure of the nerve exactly at the point of adhesion, namely, the knotty defect in the shadow of the nerve.

Fig. 10. Case VIII. Roentgenological shadow of ulnar nerve, ninety-three days after operation (neurolysis). R, traumatic neuroma, defect of shadow. K, periosteal callus.

Case IX. Paralysis of ulnar and radial nerves caused by supraepicondylar fracture of the humerus. M., male, aged thirty-four years.

The patient was admitted to the hospital with a compound fracture of his right arm at

the cubital joint caused by his being hit by the propeller of an aeroplane on March 17, 1932.

The patient had an irregular contused wound 12 cm. in length at the upper flexor side of his right cubital joint. The humerus had a supra-epicondylar split fracture, and remained just as it had been dislocated to the ulnar side. The tendon of M. triceps brachii was severed. On the back of his right hand there was a wound 10 cm. in length, and the tendon of his finger extensor was also broken. By roentgenogram we examined the supraepicondylar fracture of the humerus, and found that the lower stump was dislocated considerably to the ulnar side. In his right hand, there were split fractures of the middle and index fingers.

The wounds were drained and partly sutured. Though they caused severe suppuration and the sutured parts were opened, they gradually improved, but left a fistula at the external epicondyle. From this part I scooped out the small sequestra, after which the fistula closed naturally. The fracture of the humerus was fixed by means of bandage and splint. I found that the paralysis of the ulnar and radial nerves was due to the fracture of the humerus; and as there was typical anesthesia of the skin on the patient's hand I operated for repair of the nerve.

Neurolysis of the right ulnar nerve (June 22): Making an incision of about 8 cm. along the scar inside the right cubital joint, I searched for the ulnar nerve, and found that there was a supraepicondylar fracture where the new growth of callus was strikingly developed, and a lot of scar tissue enveloped the ulnar nerve. Removing the callus and scar tissue, I set the ulnar nerve free, wrapped the part with fat tissue taken from the upper arm and sutured the skin. The operative wound healed by primary intention.

Neurolysis of the right n. radialis (September 21): Along the course of the n. radialis, the skin was opened in the shape of an S for 17 cm. I first sought the n. radialis at the sulcus bicipitalis externus of the upper arm, and then gradually traced the lower part to find the supraepicondylar fracture. I found that the n. radialis was being pressed from the back at the point where it divides into R. profundus and R. superficialis by the upper end of the fracture and the callus, which grew from the former, owing to the dislocation forward of the end of the supraepicondylar fracture of the humerus. As the nerve adhered to the surface of the bone, neurolysis was carried out to free it by removing the fragments of bone which were pressing the nerve.

Neurolysis was carried out for 3 cm. on each branch of the nerve, from the parting point of R. profundus and R. superficialis, the nerve was wrapped up with fat tissues taken from the subcutaneus tissue in the neighborhood and the skin sutured. At that moment 0.5 c.c. of thorotrast was injected into the nerve. The infiltration of the opaque substance was clearly visualized, showing its milky color through the trunk of the nerve, though some of it leaked out to the paraneural tissue.

The operative wound healed by primary intention. About a month after the operation, the hypesthesia on the lateral part of the ulnar distribution was recovered, and movement of the fingers became a little better. The opening movement of the fingers especially improved.

Again, November 2, 0.5 c.c. of thorotrast was injected into the right ulnar nerve by means of a subcutaneous puncture.

The roentgenologic shadow of n. radialis (Fig. 11) was taken many days after the neurolysis of n. radialis, but as there was no great difference between it and that taken just after the injection of thorotrast into the ulnar nerve, I wish, for the sake of convenience, to explain about the shadows of n. radialis and n. ulnaris which were taken at the same time. Figure 11 shows n. radialis two months after the date of injection of the substance, while the latter was taken twenty-four hours after the time of injection.

In Figure 11, we can see a supra-epicondylar fracture of the upper arm. At the fracture we can also see unnatural thickness of the bones, though they have knit together. "R" shows n. radialis, visualized for 6 cm. on the upper part of the fracture line of the bone. "U" indicates n. ulnaris, and shows the shadow for 15 cm. from the region of the internal epicondyle. The form of the perineural shadow is somewhat irregular. The shadow of the nerve in the upper part is fairly

normal, but in the lower part it appears somewhat irregular.

In the lateral view we see that the humerus after the supraepicondylar fracture shows a typical dislocation with convexity forward; on the back of the bone we can see the ulnar nerve. In this figure we can see R. superficialis and R. profundus, clearly observing the radial nerve branching out to R. superficialis.

Case x. Peroneal paralysis caused by traumatic luxation of the left hip joint. M., male, aged forty-two years, examined on April 21, 1932.

The family history and anamnesis were not relevant.

At 4 p.m. the day before the diagnosis, he was carrying goods weighing 372 lbs. on his back, and stumbled with his left foot when he was just on the point of stepping over the threshold. He fell with his left side on the ground and his head to the front with the load on top of him. He was, of course, soon helped by others, and carried to the clinic on the next day. He could not move his left leg after the trauma, and complained of some pain in his left hip joint.

Present condition: The left leg was bent at 90° on the knee joint, making a severe internal rotation and adduction. On the back of the major trochanter he complained of some pain on pressure. He also felt pain at the upper part of the knee on pressure and in the hip joint on movement. It was impossible for him to move the left leg by himself. The major trochanter was situated at the upper part of the Roser-Nelaton line. At the outside of the leg there was hypalgesia, and some ecchymosis in the major trochanter, thigh and leg.

Roentgenologic findings: On the joint of the thigh there was a fracture of the bone at the acetabulum, and the head of the femur was dislocated upwards. There were no other fractures on the femur. Under general anesthesia, the left leg was at once pulled down strongly, and the luxated head of the femur was put in reposition. After roentgenographic examination to prove that the bone was in its right position, a plaster-of-Paris bandage was applied from the lower part of the abdomen down to the leg. After two weeks when the bandage was removed, I saw the left leg taking the typical position. It had some hypesthesia as well as hypalgesia on the outside, and he could not extend his leg dorsally, indicating that the left peroneus was paralysed.

Fig. 11. Case ix. Roentgenological shadow of ulnar nerve after neurolysis. R, radial nerve. U, ulnar nerve. D, adhesion of ulnar nerve on bone. P, perineurium.

Operation was carried out on May 16, 1932, under local anesthesia. About 12 cm. of skin was opened along the peroneal nerve at the left side of the popliteal fossa. On examining the peroneal nerve, I saw it running in the shallow part of the popliteal fossa on the front down to the capitulum fibulae, so the nerve formed a dislocation. Under these circumstances, the nerve seemed to be pressed between the minor head of the fibula and the plaster-of-Paris bandage, which had caused the peroneal paralysis. Part of the capitulum fibulae was cut just below the point where M. soleus and M. peroneus longus meet on the capitulum fibulae, the procedure being devised so as to allow the nerve to pass through the

lower part of the muscle and to be covered by means of a suture. The skin was also sutured. At this time 0.5 c.c. of thorotrast was injected into the peroneal nerve, and roentgenography was carried out. Ten days after the operation the movement of the leg was normal, but there still remained some hypesthesia. The patient left the hospital three weeks after the operation. He could walk normally, though some hypesthesia still remained on the back of the foot.

In the roentgenogram the peroneal nerve was seen to extend downward for 4 cm. from the capitulum fibulae, but did not show any sign of the disease.

In these 3 cases of trauma of the nerve the following roentgenograms of the nerve were visualized: two views of the ulnar nerve, one view of N. radialis and one view of the peroneal nerve.

In Case III, luxation of the peroneal nerve, we can see no pathological change in the shadow of the nerve. On the contrary, if there were any adhesion of the nerve such as to cause any paralysis of the nerve, the opaque substance injected in the periphery of the adhesion would not run toward the center over the region of adhesion but would be checked from flowing to the center by the adhesion. Therefore, the defect of the shadow of the nerve at the part of the adhesion would naturally be visualized; and also the shadow would show some irregularities, if there were any pathological change. The normal figure of the nerve will appear as a regular fibrous figure; but if the nerve has been attacked by traumatic neuritis, this normal and regular picture of the nerve fiber will naturally be disturbed. This is chiefly due to that fact that when some pathological changes have taken place in the part a knotty defect of the shadow will be visualized. In the pathological shadow of the nerve what we cannot fail to observe is the change in the shadow of the perineurium. If there is any perineuritis there must naturally be visualized some defects in the shadow of the perineurium caused by the disease. In Figure 10, we can see a remarkable change in the nerve at the height of the articular region where the perineurium was not visualized, but at the lower part of it we can see the normal perineurium. Therefore, the perineurium, together with the fibrous picture of the nerve, is of great value in reaching an accurate diagnosis, a fact which should not escape our attention.

ROENTGENOLOGIC SHADOW OF NEURINOMA

I know of no report on roentgenography of neurinoma of the peripheral nerve. I came across the following case of neurinoma and have studied its roentgenogram.

Case XI. Neurinoma, M., male, aged thirty-nine years.

Family history: The father died of apoplexy. The patient had two brothers, but his elder brother also died of apoplexy, two of the family being still alive.

Anamnesis: He had a normal birth. He had measles when he was six years old, and a severe cold when he was ten years old. Since he was sixteen years old he has been suffering from bronchial asthma, and has been used to injections with adrenalin and asthrolysin. At thirty-five and thirty-seven years of age, he had pneumonia.

Present condition: (1) About eight years ago he found a small tumor the size of a grain of rice near the right hypothenar eminence. After one year it had grown to the size of a red bean, and when it was touched he felt fulminating pain. (2) He found another tumor six years ago, as big as the end of the index finger by the side of the flexor muscle one-third of the way from the elbow to the shoulder. When it was touched he felt pain down to the end of the fingers. (3) Again, four years ago, he found a tumor as big as a red bean in the central part of the flexor surface of the lower arm. (4) Three years ago he found a tumor of the same size as the second on the flexor side one-third way up on the right lower arm. (5) In June this year (1932) he found a tumor as big as a grain of rice on the flexor side at the base of the index finger and then (6) a tumor as big as the tip of a finger grew in the central part of the right palm. (7) In July this year, a tumor as big a grain of rice appeared by the side of the flexor muscle on the right elbow. Thus there were 7 tumors on the arm. There were no

obstructions to movement or sensation, yet for the past two years he had felt severe pain, like neuralgia, of the right little finger and the

Fig. 12. Case xi. Neurinomas on right arm.

first and second phalanges of the right index finger, which sometimes disturbed his sleep. He came to a certain clinic in September, 1932, as the tumors began to grow larger, and one of those on the upper arm was extirpated. He was admitted to the hospital on October 7, 1932.

Present condition: The patient, suffering from bronchial asthma, had a wide thorax, and by auscultation râles were heard in every part and the area of heart dullness was absent. The area of liver dullness was below its normal position.

Local findings in the diseased part (Fig. 12): The numbers show the order of the formation of tumors. I will explain them according to that order.

The first tumor was at the right hypothenar eminence. It was as big as the tip of the thumb, and half of it appeared on the surface. The surface was smooth. When it was moved by pressing, it gave the patient some radiating pain affecting the whole of the right arm, especially to the end of the little finger.

A second tumor was located a little below the axillary fossa at the lateral bicipital sulcus. It was as big as a pigeon's egg, and was hard. The surface was smooth, and it was also movable. When pressed it caused a pain radiating to all of the upper limb.

A tumor located at the center of the flexor muscle of the right forearm was as big as the tip of the thumb, and hard. It was also movable.

The fourth tumor was located exactly under the arm joint on the flexor side, and as big as the tip of the index finger.

The fifth tumor was located on the flexor side of the right index finger, and was as big as the head of a small nail. It was also hard with a smooth surface, but gave no pain.

A sixth tumor, located at the center of the right palm, was as big as the tip of the thumb, with no adhesion to the skin. It was also completely movable; and when pressed caused some radiating pain to the back of the hand.

A tumor had been present within the m. bicipitalis on the flexor side of the right upper arm. However, there was left only the wound following its extirpation.

Neurinomography was carried out on October 10. By means of a subcutaneous injection of 0.5 c.c. of thorotrast into the first and second tumors, neurinomographs were taken, the result of which are as follows:

1. The tumor (Fig. 13) located in the hypothenar eminence of the right hand, was spherical in shape, 1.5 cm. in diameter. The thorotrast, being infiltrated in the periphery of the tumor, outlined its shape. By a close examination of the inside of the tumor, we could observe the cloudy figure of its construction as an irregular shadow.

2. The opaque substance having been infiltrated in the neighborhood of the tumor (Fig. 14) located at the lateral bicipital sulcus of the right upper arm, the shadow of the tumor was visualized. The shape was oval, the length 2.2 cm., and the width 1.4 cm. The long axis corresponded to the long axis of the limb. The opaque substance infiltrated in the neighborhood of the tumor accumulated at both ends of the long axis, forming

spindle shaped shadow. In this tumor also there was visible a cloudy figure indicating its construction.

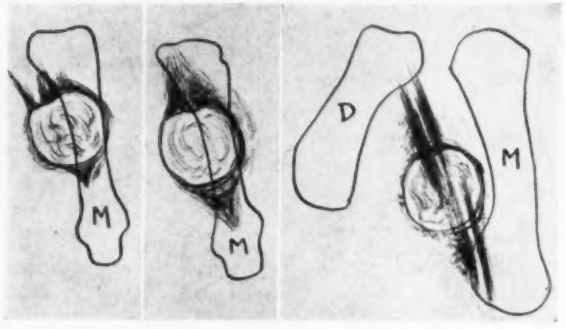


Fig. 13A. Fig. 13B. Fig. 13C.
Fig. 13. Case XI. Tumor No. 1, on hypothenar eminence. A, first day. B, second day. C, third day.

In order to examine the state of diffusion of the thorotrast, roentgenograms were taken every day or two after the injection for about one month. The results in general are shown below:

1. Observation of the first tumor (Fig. 13): The view taken on the day of injection is shown in A. The injected thorotrast gathered around the tumor as well as at both terminals of the long axis. At the same time we can recognize the cloudy figure of the construction of the tumor. The bone shown in the tumor is the metacarpal bone of the fifth finger. The view taken on the second day is shown in B. In this figure we can observe that the injected thorotrast gathered on both ends of the axis, diffused toward the center for 1.5 cm., and to the periphery for 1.5 cm. The lateral view taken on the ninth day after the injection is shown in Figure C. D represents the metacarpal bone of the thumb, and M shows one of the shadows of the bones. The tumor was spherical. The medium is shown extending 2 cm. toward the center and 2 cm. toward the periphery. Two shadows, shaped like belts and running in parallel are seen; and between these two shadows we can see a shadow like a string through which the opaque substance penetrated. The view taken after one month demonstrated that the string-like shadow reached to the neuroma and that it was the shadow of the nerve trunk which came out of the neuroma. The cloudy figure in the neuroma had not yet faded at all.

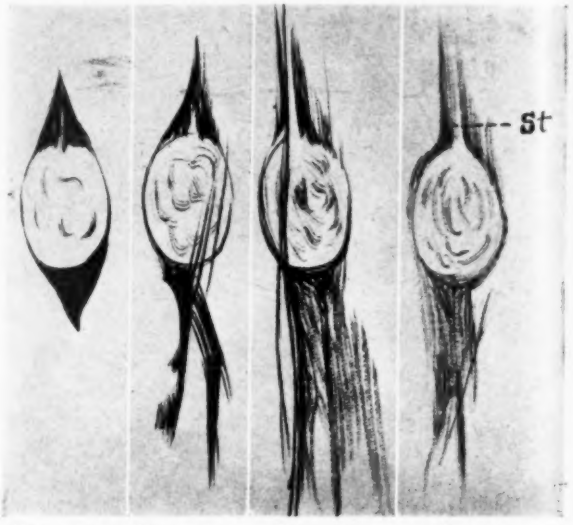


Fig. 14A. Fig. 14B. Fig. 14C. Fig. 14D.
Fig. 14. Case XI. Tumor No. 2, in upper arm. A, first day. B, second day. C, eighth day. D, one month.

2. Second tumor (Fig. 14): The figure taken on the day of injection is shown in A. In this we can see that the opaque substance gathered at the upper and lower terminals, forming a triangle and embracing the tumor from above and below. Thus, as a whole, it presents a shape like a spindle. In the tumor we can also observe a cloudy construction.

The figure taken on the second day following injection is shown in B. The opaque substance gathered at both terminals had been diffused 2.3 cm. toward the center. Toward the periphery it diffused in a fork 3.5 cm. in length. There is a transparent zone shaped like a band between the shadows formed by the diffusion. We can now observe the cloudy figure of the tumor's construction more minutely.

The view taken on the eighth day is shown in C. In this the opaque substance was diffused towards the center for 2.5 cm., and distinctly parted into two branches. We could observe a band-shaped transparent figure between them, and from top to bottom a vertical line through the tumor

was recognized. Toward the periphery the opaque substance had been diffused for 5.5 cm. There was also a transparent belt-shaped shadow between the double shadows of the diffusion. I think this was chiefly due to the roentgenogram of the stem of the nerve taken vertically. The shadow which runs vertically through the tumor seems to be a stem of the nerve passing by the lateral side of the tumor.

The roentgenographic figure taken after one month is shown in D. This figure clearly showed that the opaque substance was fairly absorbed, and that a stem of the nerve entered the tumor from its main terminal. It seems to me that the stem of the nerve which runs toward the periphery cannot be considered to be the one which comes directly out of the neuroma.

3. The roentgenographic figure of the third tumor taken after injection of 0.5 c.c. of thorotrast into the neuroma in the center of the flexor side of the right lower arm October 25 is shown in Figures 15 and 16. R shows the radius, and U the ulna. In this case the opaque substance was injected into the tumor itself to some extent, but chiefly in the neighborhood of the tumor. Therefore, it shows also the figures of the muscles and some other parts which were roentgenographed.

The figure taken on the day of injection is shown in Figure 16A. Here an oval neuroma is seen, 2.2 cm. in length and 1.5 cm. in width. The opaque substance was diffused upwards about 6 cm. Considering the neuroma as a spherical root, it looks as if the stem had come up out of the root; and we can see a transparent belt-like figure. The opaque substance in this case is not at all diffused toward the periphery.

The view taken on the second day after the injection is shown in B. In this figure the opaque substance is diffused toward the center for about 7.5 cm., but not toward the periphery.

The figure taken on the twenty-second day after the injection is shown in C. Here we can also observe that the opaque substance is diffused a little toward the center, and can also recognize its diffusion toward the periphery in a cloudy figure,

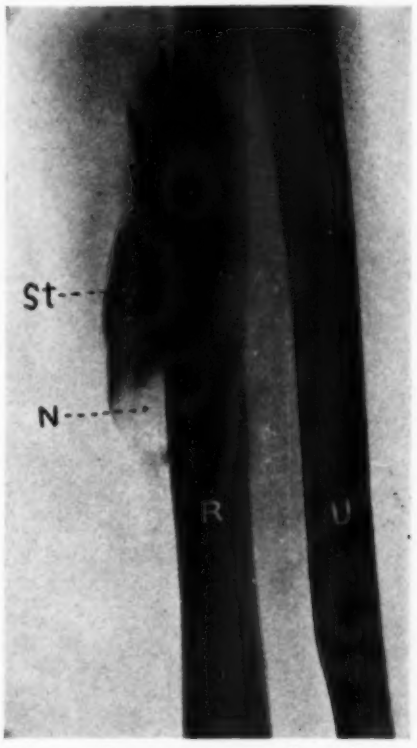


Fig. 15. Case XI. Roentgenogram of neurinoma No. 3. R, radius. U, ulna. N, neurinoma. ST, pedicle of neurinoma.

while we cannot see any structural figure within the neuroma.

4. Roentgenological findings about the tumors: A roentgenogram was taken after injecting 0.3 c.c. of thorotrast into the neuroma located on the flexor side at the root of the right index finger on October 18. As it would not be clear if roentgenographed from the back of the hand, because of the shadows of metacarpal and digital bones, it was taken from the direction of the little finger toward the thumb. In this figure (Fig. 17) we see a neuroma as big as a red bean. The opaque substance injected into it was diffused for 1.5 cm. towards the center, and 1.0 cm. toward the periphery. Thread-like figures of the neuroma were observed on both sides of it.

Operation: An operation was performed on August 11, 1932, using local anesthesia.

The first neuroma was located in the volar side of the little finger, growing from ramus superficialis N. ulnaris. Nerves came out shows the neuroma. For this reason, the neuroma was extirpated after amputation of the nerve axis.

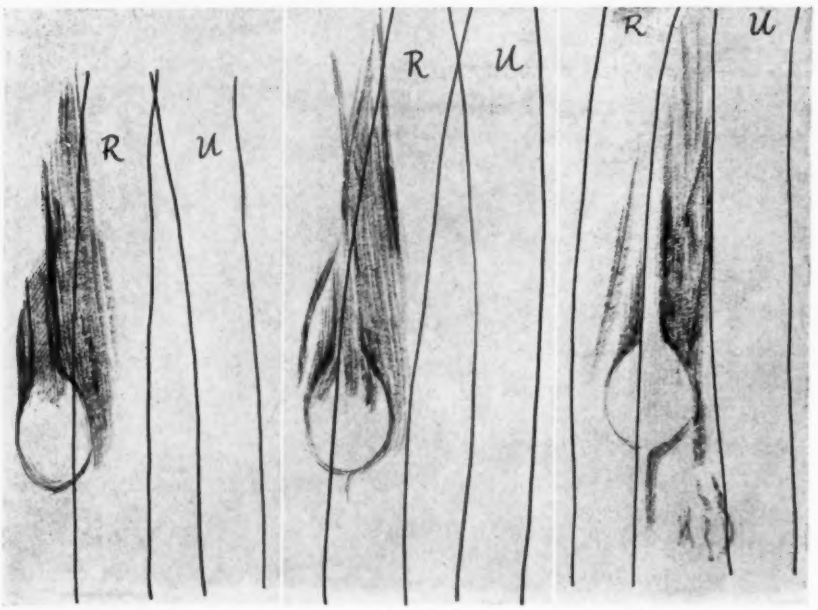


Fig. 16A. Fig. 16B. Fig. 16C.

Fig. 16. Case xi. Neurinoma No. 3 in forearm. A, Directly after injection. B, After two days. C, after twenty-two days.

of both ends of it, so the neuroma was extirpated and the nerves sutured (No. 1 in Fig. 17).

The second neuroma was located in the center of the upper arm, just between the M. biceps brachii and the triceps. It seemed to be growing out from N. cutaneus antibrachii medialis. In the center of this neuroma there was a nerve, but there was no stem of the nerve on the periphery. The neuroma had grown on the tip of a nerve axis like an apple hanging on a stem. This finding corresponds to that of the roentgenological figure. Figure 18

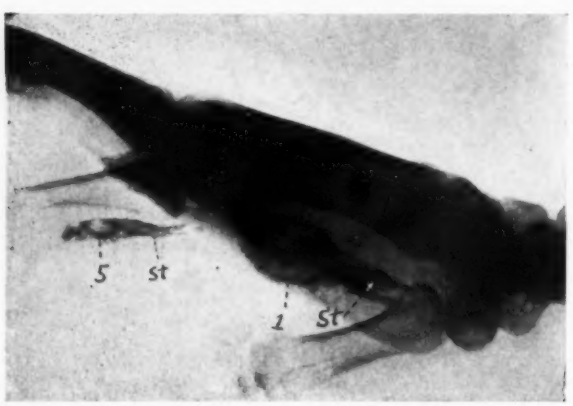


Fig. 17. Case xi. Roentgenogram of neurinomas No. 1 and No. 5. st, pedicle of neurinoma.

The third neuroma was located on the flexor side in the center of the lower arm. It was as big as the volar side of the thumb on the N. medianus at the bottom of the opening in the muscles. There was a stem of the nerve at each end of the neuroma, so it was cut out. The nerve was then sutured, and wrapped up with fat tissue cut from the upper thigh. On both sides of the extirpated neuroma we could see the ends of the severed nerve stem.

The fourth neuroma was located one-third of the way up the lower arm. In M. flexor carpi ulnaris, there were found two neuromas with pedicles: one was as big as the head of a small nail, while the other resembled a grain of millet. They were both cut off.

The fifth neuroma was located on the volar side of the index finger, growing out from N. digitalis proprii medialis. It was extirpated, and wrapped with fat tissue, after nerve suture.

Histological examination of the neuromas:

By a histological examination of the extirpated neuromas we found that they consisted of parenchyma resembling the nucleus dentatus cerebelli and interstitium. The former consists chiefly of spindly cells with a fibrous structure, the nucleus of which is oblong. The tissues,

like the nucleus dentatus cerebelli, are curved like a belt, or merely exist as a lump tissue, and are of ectodermal origin. Among them is found interstitium of mesodermal origin, composed of connective tissue, and having blood vessels. On its loose part the neuroma had degenerated into a myxoma-like condition. The deposit of thorium dioxide was chiefly present in the interstitial cells giving them a brown granular appearance in round or spindle form. Under strong magnification, such cells are seen to be crowded with it, and we know that those which are isolated are round, and their nucleus excentric, and that they have poor chromosomes. They are, therefore, considered to be histiocytes. However, it is still a question whether or not thorium dioxide is deposited in the parenchymatous tissue of the nerve.

In short, these tumors are all amyelinic neuromas. When stained by the Van Gieson method, the interstitium shows scarlet from the acid fuchsin, while parenchymatous tissue shows yellow from picric acid, and between them there are fine connective fibers dyed by acid fuchsin. By silver impregnation according to the method of Bielschowski, a few of the axis cylinders will be dyed, but they are seen only in the nerve tissue.

As already stated, when thorium dioxide solution, thorotrast, was injected directly into the neuroma by means of hypodermic puncture, the solution not only infiltrated into the tumor, but also escaped into the neighborhood, which naturally made it possible to visualize even the stem of the nerve. The injection of the opaque substance itself revealed the shape of the tumor clearly owing to the collection of the injected solution in the neighborhood as well as on both terminals of the neuroma.

In the first tumor, that on the tip of the little finger (Figs. 13 and 17), the injected solution was collected at both poles and so the tips of the stem of the nerve were clearly visualized. In the second tumor, the neuroma in the upper arm (Figs. 14 and 18), the solution collected at both poles, forming a triangle and infiltrated toward the center and the periphery as time passed. Yet in the center the stem of the nerve which entered directly into the neuroma was revealed clearly. In the periphery the neuroma

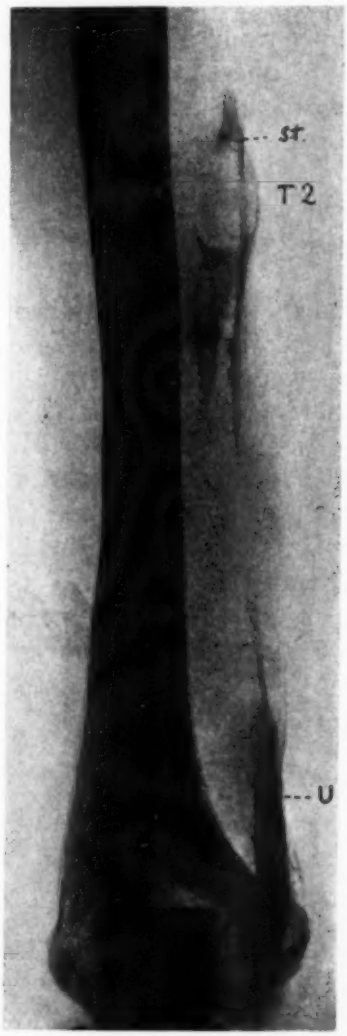


Fig. 18. Case xi. Roentgenogram of neurinoma No. 2. st, pedicle of neurinoma. u, ulnar nerve.

was rounded, and the stem of the nerve which ran toward the periphery by the side of the neuroma was distinctly visualized. It was proved by operation that the neuroma was connected directly to the stem of the nerve on its central aspect only, like an apple hanging on a branch. Thus the roentgenological figure agreed exactly with the operative finding.

In the third neuroma (Figs. 15 and 16), located in the center of the forearm, the stem of the nerve connecting the center and periphery was visualized very clearly. Even in the fifth tumor (Fig. 17),

the neuroma on the volar surface of the index finger, the same was true. The neurinomography revealed not only the shape of the neuroma, but also the stem of the nerve which entered into it. The opaque substance injected into the neuroma formed an exact shadow of its structure, and also gave an irregular shadow, just as if the nerve fibers ran through the neuroma.

CONCLUSION

By means of injecting thorium dioxide solution, thorotrast, into the ulnar nerve, the nerve was roentgenographed for a maximum length of 39 cm. The picture taken by this method revealed not only the shadows of the nerve fibers, but also the internal and external sheaths of the nerve. It is, therefore, quite possible to use it for neurohistography. If it is applied to an injury of the nerve, it will clearly reveal the shadow of the injured part. That is to say, the opaque substance injected into the periphery will not infiltrate into the center over the scar on the nerve caused by the wound. So a defect in the shadow of the nerve will naturally be visualized where the scar is. It is, therefore, easy to believe that this method will be a great help in roentgenological diagnosis in cases of injury to nerves. If it is applied to the diagnosis of neuroma, it will not only show the form of the neuroma itself, but will also reveal its structure, together with the stem of the nerve penetrating into the neuroma. This being the case, it will be quite useful in indicating treatment; yet it will not interfere in any way with the function of the nerve, nor produce any after-effects such as neuralgia. As the experiences cited have proved that this method brings no harm to the nerves, it is highly recommended as the best method of clinical diagnosis.

REFERENCES

1. Saito, M., Kamikawa, I., and Kato, K. Roentgenography of peripheral nerve. *Rep. Japan. Ass. Sc.*, 7: No. 2 (July) 1932.
2. Saito, M., Kamikawa, I., and Yanagizawa, H. *Nippon Gekagakkwai Zassbi* 31: No. 5 (Aug.) 1930.
3. Saito, M., Kamikawa, K., and Yanagizawa, H. Neuvelle méthode de radiographie des artères et des veines. *Presse méd.* No. 107, (Dec.) 1930.
4. Saito, M., Kamikawa, K., and Yanagizawa, H. A new method of blood vessel visualization (arteriography, veinography, angiography) in vivo. Am. J. Surg., n.s. 10: No. 2 (Nov.) 1930.
5. Saito, M. *X*-ray diagnosis of cerebral tumours. *J. Coll. Surg. Australasia* (July) 1930.
6. Saito, M., Kamikawa, K., and Yanagizawa, H. On the roentgenograms of blood vessel in vivo. *Rep. Japan. Ass. Sc.*, Vol. 6, 1930.
7. Saito, M., and Kamikawa, K. A new modification for the injection method of arteriography (injection in refluence). Am. J. Surg., n.s. 17: 16 (July) 1932.
8. Saito, M., Kamikawa, K., and Kato, S. Roentgenological visualization of the peripheral nerves, neurography in vivo. Am. J. Surg. n.s. 22: 78 (Oct.) 1933.
9. Saito, M. Neurography, especially on the pathological figure. *Aichiigwakkwai Zassbi* (Nagoya.) 39: 1234.
10. Fujimoto, I., Kamikawa, K., and Tashiro, K. Roentgenography of lymph system in vivo (lymphography). *Tokyo Iji Sbinsbi*, No. 2772 (April) 1932.
11. Nakashima, S. Absorption from joint, especially on the absorption of colloidal substance. *Tokyo Iji Sbinsbi*, No. 2786 (Aug.) 1932.
12. Tashiro, K. Roentgenological and histological study of lymph system in vivo. *Nippon Gekagakkwai Zassbi* No. 33 (Apr.) 1933.
13. Nakamura, H. Sixty-six cases of injury of peripheral nerve, and method of roentgenography of the peripheral nerves by means of thorotrast. *Tokyo Iji Sbinsbi*, No. 2810 (Jan. 24) 1933.
14. Spitzer, B. Experimentelles Ergebniss zur Frage der dentalen Neuritis des Trigeminus. *Arb. a. d. neurol. Inst. a. d. Wien. Univ.*, vol. 34: 1932.

DEATH FROM APPENDICITIS

A PREVENTABLE MORTALITY*

CHARLES GORDON HEYD, M.D., F.A.C.S.

NEW YORK CITY

A DISTINGUISHED clinician once said that only intelligent people died of appendicitis. A generalization of such magnitude is incorrect but it does express a background for an appraisal of the deaths from appendicitis. A perusal of the newspapers will reveal almost weekly the death of some distinguished citizen from appendicitis.

Within very definite limitations there should be no deaths from appendicitis. The presence of pus, gangrene or general peritonitis at the time a patient is operated upon for appendicitis is in a large measure proof that the case has been neglected or delayed. Appendicitis today is one of the greatest lethal conditions in our active, well-bodied and healthy individuals. The deaths that do occur are largely the result of (1) cathartics, (2) failure to make an early diagnosis, (3) a lack of confidence in the early diagnosis, (4) failure to recognize the gravity of appendicitis, (5) medical procrastination, (6) surgical postponement, and finally, (7) incorrect or faulty preoperative and postoperative treatment.

The symptomatology of acute appendicitis parallels the pathological process and with rare exceptions acute appendicitis has a definite sequence of symptoms because it is based upon a continuing and accelerating pathological process. The consideration of the physical, anatomical and chemical bases of appendicitis is an advantage in approaching this subject. The ileocecal valve is a great physiological partition point. There is some degree of physiological stasis in the small intestine; in the cecum there is the greatest fluidity of intestinal contents, the highest and most varied bacterial count and a change from the alkalinity of the ileum to the mild acidity of the colon. Furthermore there is a relative sphincteric action of the ileocecal valve with the greatest aggregation of lymphoid tissue in the ileocecal angle. This lymphoid tissue offers a protection against bacterial invasion of the ileocecal region. Adami demonstrated many years ago that in conditions of apparently normal health bacteria could and did migrate through the intestinal walls and with the addition of some other disturbing causes were capable of being activated into an infection of varying virulence or severity.

The appendix itself is a blind tube of variable lumen which in the adult has its narrowest portion with the junction of the cecum, sometimes called the valve of Gerlach. In the adult a strong inelastic submucous tissue is present throughout the entire length of the appendix and acts as a very strong retaining sheath for the products of infection within the appendix. In all but about 12 per cent of cases the blood supply to the appendix is terminal and essentially a terminal circulation. A deficiency of serosa at the mesentery represents its weakest luminal point and fecoliths or foreign bodies are present in approximately 40 per cent of the appendices removed in the course of laparotomies for other conditions. The absence of the submucous layer and the wider lumen of the appendix in children is responsible for the lack of sequence of the symptomatology in children. In

* Delivered as part of Special Symposium on Appendicitis Mortality, Northampton County Medical Society, Easton, Pa.

children under twelve years of age there is a greater tendency for intracecal drainage of the appendix but a greater ease of perforation owing to the absence of the submucous layer.

The underlying cause of appendicitis is always an infection and this infection begins in almost 99 per cent of cases in the mucosa. There is a rapid swelling of the mucous membrane which cannot expand owing to the firm retaining fibrous tissue of the submucous layer; the products of infection are thus retained under pressure and an empyema results. The symptomatology that follows this rather simple pathological process begins by the onset of pain which is colicky in character, occurs suddenly, is severe and recurrent in character. It is a primary peritoneal pain due to violent peristalsis of the small intestine and is referred to the epigastrium. Hyperperistalsis associated with intermittent colicky pain occurs only above the provoking cause (Murphy). Associated with the onset of pain is usually the development of a sense of nausea, occasionally vomiting, and if cathartics or salts are not given these two features rapidly subside. The abdomen is generally sensitive though not necessarily spastic. An accurately taken rectal temperature record will reveal some slight elevation in temperature. With the rarest exception the onset of symptoms is paralleled by leucocytosis and polynucleosis of some degree. An infection thus having started in the appendix will terminate in one of three ways: (1) drainage through the appendix into the cecum with resolution: (2) perforation, or (3) a combined suppurative and gangrenous process. The moment the infection reaches the serosa the general abdominal symptomatology changes and the symptoms and signs point unerringly to a pathological process in the appendix. The pain becomes constant in character, is localized to the right lower quadrant, nausea and vomiting have ceased, the generalized abdominal sensibility has become a local tender point capable of accurate focalization and for the time being the temperature subsides, although the leucocytosis and polynucleosis continue or increase in their counts. At this stage the condition is usually diagnosed as appendicitis although pathologically it is essentially a localized peritonitis. Perforation, rupture or gangrene means that the pus pressure of the empyema is temporarily relieved and absorption for the time being is diminished but the danger to the individual has become markedly increased. It is unfortunate that it is at this stage that surgical postponement and medical procrastination take place. The moment the serosa becomes involved the peritoneum of the surrounding intestines begins to throw out first a transudate, then an exudate. This is manifest in the form of a plastic lymph or fibrinous material and is truly protective and for the purpose of enclosing or erecting barriers against the spread of the peritoneal infection. The intestines are held fixed distention occurs and peristaltic activity is inhibited. The patient, family or friends attempt to correct the abdominal distention by recourse to drastic cathartics with the result that a local peritonitis is rapidly converted into a condition of ascending pathological severity and the development of a generalized peritonitis.

In my boyhood I can distinctly recall a number of useful citizens who died under the circumstances I have portrayed and the death certificate bore the cryptic legend "inflammation of the bowels." In a later day a great number of individuals were buried from a fatal issue of "intestinal flu" and a still greater number of individuals have died in the attempt to cure acute appendicitis by thinking it was ptomaine poisoning and giving what Murphy used to describe as the "death-producing lullaby of castor oil."

If one reflects that the individual who develops acute appendicitis is ordinarily an individual enjoying good health, who has had a sudden attack of abdominal pain and just at that moment, he should

be strongly suspected of having appendicitis. In no field of surgery are the errors of omission associated with such a terrible mortality, and in a like measure in probably no other field of surgery are errors of commission attended with such slight risks to the individual. As a matter of surgical philosophy it would seem that it were better to take out a perfectly innocent appendix than to face the menace of perforation and peritonitis.

There are very few abdominal conditions that arise in as precise a manner as appendicitis and it is well to remember that the sudden onset of acute, cramp-like abdominal pain is the first and most important warning symptom of appendicitis. The reaction of the individual with this condition is interesting and the treatment of his own condition is one of the tremendous and outstanding extra-hazards that he takes upon himself. The patient, as we will call him, believes that he has an acute stomach or bowel upset; that he must have eaten something that disagreed with him; that he has ptomaine poisoning and he therefore proceeds to treat himself by taking a laxative in the form of epsom salts or magnesium citrate, or a more drastic cathartic, such as castor oil. In many cases by so doing he unconsciously and unwittingly writes his own death certificate. Of 402 patients who had acute appendicitis but did not take a laxative one out of 80 died: of 992 who took one laxative one out of 14 died, and among 992 patients who took two or more laxatives one of 7 died: the deduction is obvious! The taking of a cathartic initiates an attempt upon the part of the appendix to empty itself, which is mechanically impossible by reason of the inflammation, and the result is that the appendix perforates or ruptures and peritonitis follows.

There is only one treatment for appendicitis and that is surgical intervention, with or without the removal of the appendix. Surgery is ordinarily undertaken in four different stages: (1) the first stage in the beginning of the attack before perforation or gangrene has occurred; (2) the second stage after perforation or gangrene has occurred when the surgical intervention is made during an ascending pathological process; (3) in individuals who by the grace of God have survived perforation or gangrene and developed a localized abscess where surgical intervention is performed during a period of decreasing pathological progress. (4) The so-called interval or intermediate operation.

The individual with a diseased appendix or one who has had a previous attack has the sword of Damocles constantly suspended above his head. Every time he goes away, into the woods to hunt or fish, every time he leaves civilization, every time he takes a trip across the ocean, he carries with him the hazard and the menace of an acute attack of appendicitis. Recall to your mind the number of your friends and acquaintances that have had attacks of appendicitis while away from home either here or abroad. Recall the number of prominent names listed on the front pages of the newspapers, of patients who have either died of appendicitis or recovered after weeks of illness.

Increasing experience and analysis of the martyrdom from acute appendicitis indicates that there are certain rules with which both the public and the profession should be thoroughly acquainted: (1) Absolutely nothing must be taken by mouth—no food, no water, no medicine; abstention from food and water for a few hours can do no harm and it may mean all the difference between a mild attack of acute appendicitis and a severe attack with gangrene or rupture of the appendix; no medicine should be taken; acute appendicitis is not influenced by medicine and to take any medicine by mouth violates the principles of this rule. (2) Under no circumstances give a laxative or a cathartic. (3) Send for a competent surgeon; he has the knowledge, experience and special ability together with the clinical laboratory for determining exactly what is the pathological condition present: (4) Have the patient remain inactive; the patient usually believes that a game of handball or a Turkish bath is the way to "run out" an abdominal pain; inflam-

mation or infection of the appendix is increased or made worse by activity. Finally, we come to another large question involved in this presentation; what shall be done for the patient who has a mild attack of acute appendicitis and recovers without an operation? Again, what should be our advice to an individual who has just had such an attack and is recovering? For the last decade the medical profession have been attempting, successfully to be sure, to spread important information in regard to preventive medicine: the periodic health examination, a physical "check off" of the human machine, once or twice a year, and as part of this educational program there has been a subdivision, spoken of as preventive surgery. The treatment of appendicitis is surgical. The individual with an acute appendicitis needs surgery, needs it quickly and stands a better chance of being alive after it than by any other treatment known. Surgery in the early stages is safe. The patient makes a good recovery, with a quick return to normal well-being and activity. Equally important is, that by operation, the appendix is removed, the possibility of recurrence obviated and the menace of appendicitis forever dispelled.

The moment the physician is called to a patient complaining of abdominal pain he should have a well-rationalized procedure before him. This would involve a consideration of the factors of correct and adequate preoperative and postoperative treatment. The surgical considerations are (1) to prevent perforation or gangrene; (2) to keep a local peritonitis strictly local; (3) to have adequate and effective surgical intervention. The last does not necessarily mean the removal of the appendix but means to bring about a cessation of the retention of the products of infection under pressure. That is the outstanding surgical consideration. Surgical intervention may represent only a small opening in the abdomen and the institution of drainage. An adequate preoperative and postoperative treatment will embrace a combination of the principles enunciated by Ochsner and Murphy. Consider that the surface area of the peritoneum is almost equal to the surface area of the body of the individual and represents some 16,000 square inches and that the peritoneum can, under certain circumstances, absorb 8 per cent of the body weight in an hour and further that there are varying degrees in the rapidity of absorption depending upon the area of the abdomen involved. The most rapid absorption and the most dangerous area is in the upper abdomen, the peritoneum covering the diaphragm, liver, stomach, lesser peritoneal cavity: the least dangerous area of absorption is the pelvis. When the physician considers that the greatest biological stimulant of peristalsis is the taking of food or fluid into the stomach and that peristaltic activity is the single, outstanding cause in the dissemination of infectious material in the abdominal cavity; with these desiderata in mind it is obvious that the patient should be placed in the Fowler position, that absolutely nothing should be given by mouth, that water balance should be maintained by the giving of fluid by rectum, by hypodermoclysis or by the intravenous route; that a small enema will provide all of the necessary evacuation of the lower bowel that is wise or necessary; that all physicians, internists or surgeons, should believe and act upon that belief, namely, that appendicitis should be subjected to surgical intervention at the beginning; while delay, procrastination and postponement will never represent surgical or medical attainments but only a roster of martyrs from appendicitis.

SUMMARY

1. Emphasis is placed upon the fact that the symptomatology of acute appendicitis is directly sequential to the pathological process.

2. Infection is the underlying factor.

3. The administration of cathartics is the largest single death-producing factor.

4. Appendicitis is a surgical condition.

5. The desirability of early surgery is stressed.

6. The preoperative and postoperative measures to be carried out are outlined.

ACUTE APPENDICITIS IN THE AGED

A STUDY OF 43 CASES OCCURRING AFTER THE AGE OF SIXTY*

CORNELIUS B. WOOD, M. D.

BOSTON

THE diagnosis and treatment of appendicitis continue as major surgical problems. So much has been written upon the subject that it is becoming the custom to start any paper concerning it with an apology. And yet, in spite of the great experience at hand and the careful study given this matter, the mortality of appendicitis continues to be alarmingly high. The mortality of acute appendicitis in youth and the early adult periods has remained at about 4 per cent for the last two decades. The mortality of acute appendicitis in the aged is variously reported at about 25 per cent. This paper is based upon a study of the records of the 43 cases of acute appendicitis in patients beyond the age of sixty occurring in the Peter Bent Brigham Hospital since 1913. It is an attempt to draw some conclusion from them as to why appendicitis in the aged is such a lethal disease.

There is every reason to suppose that the peritoneum and the appendix of a patient, in the late decades of his life, would react differently to inflammation than they would have reacted in his youth. The appendix, until the age of twenty, shows increasing amounts of lymphoid tissue, and from that time on the amount diminishes, and there occur atrophic and fibrous changes. G. S. Huntington[4] examined 200 appendices of adult cadavers, and in these found that the various serosal folds were adherent, obliterated, or absent, and in 20 newborn babies, examined at the same time, these characteristic folds were regularly present. Aschoff's[1] explanation of these changes in the adult appendix is that they are the results of cicatrization, following repeated invasions of the wall by bacteria of low virulence or in minute doses. The probability of recurring attacks of appendicitis increases with each additional year of life. Maes[6] has shown that repeated attacks of appendicitis seem to confer on the patient at least a relative degree of security. In a study of acute appendicitis in children, those cases that had had former attacks of appendicitis had pathologic changes of much less severity, and the death rate was just one-half that of cases not having had previous attacks of appendicitis.

There are reasons, other than these anatomical ones, why appendicitis in the aged varies from that manifested in youth. Lewin[5] has pointed out that the reaction of tissue to inflammation in old age is characterized by a long period of development, and when established there is a tendency to chronicity. He believes that it is this behaviorism of the peritoneum in the aged which so masks the usual appendicial complex of symptoms. Furthermore, the lowered sensitivity of these people to pain allows the inflammatory process to become well advanced before the discomfort forces them to consult medical aid. The sluggish intestinal gradient of the aged, as manifested in so many older patients by increasing constipation, is little disturbed by reflexes. Consequently, the feeling of malaise and nausea and the act of vomiting are not marked or of uniform occurrence. Perhaps a further, powerful reason for the altered symptom complex in the aged is due to their natural

* From the Surgical Clinic of the Peter Bent Brigham Hospital.

inclination to believe that old age places them beyond the hope of surgery. Thus they attempt to conceal symptoms until they have become severe. Rarely are these patients seen until they have been ill for several days, and the inflammatory process is well advanced.

PATHOLOGY

A study of the operative records and pathologic reports on these 43 cases of appendicitis, in aged patients, convinces one that appendicitis, with them, was always a severe and already extensive inflammatory disease. Thus, in this group of cases, 55 per cent of the patients, at the time of operation, had appendicial abscesses. Nine per cent of the cases, when operated upon, already had a generalized peritonitis, and 16 per cent of the cases had a gangrenous appendix. Thus, a total of 80 per cent of these patients showed very serious pathologic changes in the appendix. In the remaining 20 per cent, the disease was the simple acute or the acute suppurative variety.

TABLE I
PATHOLOGY AND MORTALITY AT THE TIME OF OPERATION

	Per Cent of Cases	Number of Cases	Mortality
Appendicitis with slight localized peritonitis	18.6	8	25
Gangrenous appendicitis	16.2	7	14
Appendicitis with abscess formation	56.0	24	25
Appendicitis with diffuse peritonitis	9.3	4	75

In the whole group, including even those classified as less severe, the inflammatory changes were localized to the appendix in but few cases. Practically all of them showed some localized peritonitis in the adjacent loops of gut. At operation the loops of gut in the right iliac fossa were characteristically reddened, injected, and quite thickened and edematous. The distal cecum was most usually involved in this process, and, in the majority of cases, so thickened and so friable that invagination of the appendicial stump was difficult, and in a few cases impossible.

The occurrence of appendicial abscess in many of these cases came as a distinct surprise to the operator. The preoperative signs and symptoms in but a few cases justified such a diagnosis. There was no correlation between the duration of illness and abscess formation. Thus, many of the patients with abscess had had symptoms but two or three days. Others had noticed increased constipation or vague abdominal discomfort for weeks previous to admission to the hospital. A few of the cases that had had no symptoms until thirty-six hours before operation were found to have well walled-off abscesses of considerable chronicity. On the other hand, other cases that had been ill for ten to fourteen days with crampy abdominal pain, nausea, anorexia and constipation, at operation showed pathology of much less severity. These incidences emphasize the insidiousness of this malady in the aged, and point out the difficulty in the diagnosis of this syndrome.

Nine per cent of the cases, when operated upon, already had a generalized peritonitis. This figure, while high, is the same as that published by Beekman et al.,[2] in the analysis of 500 cases of appendicitis occurring at all ages. Considering the duration of symptoms in this group, and the severity of the disease, it can be safely said that the peritoneum in aged persons tolerates and limits the infection quite efficiently.

SYMPTOMS

The clinical syndrome of acute appendicitis differs somewhat from that manifested in youth. The theoretical reasons for such an altered picture have already been suggested. Any categoric statements concerning the symptoms of appendicitis in the aged, and their sequence of occurrence, becomes more obviously unreliable as these cases are studied in detail. One should become increasingly on the alert for the possibility of acute appendicitis, in the

diagnosis of any intra-abdominal pathology in these aged patients. The symptoms of this entity may follow the established clinical, clear-cut sequence. But again, the symptoms may be entirely atypical, and so closely simulate the picture of intestinal obstruction and carcinoma that operative interference may be delayed.

The aged, in contradistinction to younger patients, frequently showed prodromal symptoms before the development of definite appendicial symptoms. Thus, 54 per cent of the patients had been caused discomfort by slight symptoms several days before becoming definitely ill. These consisted in abdominal pain and discomfort, vague in character, and not localized. Anorexia and some increasing constipation were noted in a few cases. However, these symptoms had been, in most cases, so inconsequential as to be elicited only upon considerable questioning.* Sixteen per cent of the total cases had had, within the year before admission, definite, and in most instances, diagnosed attacks of appendicial symptoms.

The definite onset of symptoms in 95 per cent of the cases began with abdominal pain. This was usually crampy, intermittent in character, and occasionally sharp and knife-like. In one-third of the cases, the pain began in the epigastrium and shifted to the right lower quadrant. In approximately another one-third of the cases, the pain was generalized and crampy, and not localized, and in the remainder, the pain was localized in the right lower quadrant during the whole of the attack. Vomiting in these patients occurred in but 53 per cent of the cases. Anorexia and slight nausea were present, in a more or less degree, in most of the cases.

Most striking of all the phenomena in the aged patients was the presence of moderate abdominal distention. In 55 per cent of the cases this was so prominent as to produce the impression of partial intestinal obstruction. This feature, in combination with intermittent, crampy, abdominal pain, and a history of increasing constipation led to the erroneous diagnosis of intestinal obstruction in a certain number of cases. Gatewood[3] has similarly stressed this occurrence of abdominal distention in acute appendicitis in the aged.

In reviewing the symptoms of these cases, an attempt was made to classify them. They were divided into two groups, those having a more or less typical syndrome complex suggestive of appendicitis, and those whose symptoms were atypical and in no way an aid to the diagnosis. Fifteen cases fell into the latter group, and 22 into the former. Five additional cases were questionable.

The average white blood count was 16,000, and there occurred but 8 cases in which the white blood count was under 10,000. The temperature for the group averaged 100.2°F. upon admission into the hospital, and only 6 cases showed a temperature under 99.0°F. The highest was 102.4°F. The pulse in these aged people averaged 95 per minute. Tenderness in the right lower quadrant over McBurney's point was the most constant finding of any sign, and this occurred in practically all cases. Spasm, on the other hand, was frequently absent, and when present it was not marked. Distention was recorded as being present in over half of the cases.

DIAGNOSIS

An interesting impression, though not substantiated by any figures, is obtained from the study of these records, and from the cases that were seen personally. These patients when first seen do not appear to be seriously ill. The history, physical findings, and laboratory data frequently conceal the seriousness of the pathology.

The diagnosis can be made in many cases only with considerable misgivings. The diagnosis, even in the presence of a fairly typical history, may be missed because of the supposed rarity of this disease

* It is probable that these cases represent the most mild attacks of appendicitis which later become distinctly severe, and that the definite symptoms appeared only when the pathological changes had become marked.

in the aged. The marked abdominal distention, suggesting intestinal obstruction, may lead to an attempt to locate a suspected neoplasm, with the subsequent loss of valuable time.

In this group of cases only 62 per cent were diagnosed acute appendicitis before operation. The majority of the remaining 38 per cent were diagnosed as carcinoma of the large bowel or intestinal obstruction.

OPERATION AND POSTOPERATIVE COURSE

The operative procedure in 36 cases consisted in the removal of the appendix, although in 4 of these cases the cecum had been so thickened and inflamed that invagination of the stump was impossible. In 7 cases the appendix was not removed, and only a drain was inserted and the wound closed with drainage. Swarn and Fitzgibbon[7] in 487 cases of appendicial abscesses showed that appendectomy with drainage gave a 15 per cent mortality, but a simple drainage followed later by appendectomy gave but a 4 per cent mortality. In this small group of patients simple drainage, with or without a subsequent appendectomy, carried a 57 per cent mortality. This, of course, does not express the true factors, for in 5 of these 7 cases, the plastic inflammatory process had so buried the appendix that a moderate search failed to locate it.

The postoperative course of these patients was rather noteworthy. Other than in the extreme cases, the severity of the disease process seemed little related to the ease of convalescence. Patients who seemed very ill upon admission, and who showed gangrenous appendicitis with abscess formation, seemed to recover with few complications and discomforts. However, those cases of appendicitis in which the surrounding inflammation was minimum, and in which drains were not employed, had the least number of complications and the most rapid recovery.

In general, the postoperative course could be classified as uneventful, moderately severe, or stormy. Eighteen patients recovered with an uneventful convalescence, 12 had a moderately severe course, and in 13 the postoperative course was stormy.

Drains were used in all but nine instances. Surprisingly marked is the low incidence of fecal fistula resulting from drainage in these aged patients with severe inflammation involving the base of the appendix and cecum. Fecal fistula occurred but five times, 2 of these patients died from other complications, and in the remaining 3 cases the fistula closed within one and one-half months after operation.

Postoperative wound infection in the cases drained occurred in 40 per cent of the patients. In a few of these the infection presented a serious complication, which, in one instance, resulted in widespread gangrene of the abdominal wall.

These elderly patients ran elevated temperatures after operation for several days, the average duration of this fever being eleven days. The patients on an average were allowed out of bed on the eighteenth day.

MORTALITY

Twelve patients died following operation, a 28 per cent mortality. This high mortality figure seems nearly prohibitive, but an analysis of the factors shows them to be a necessary accompaniment of any

TABLE II
RELATION OF DURATION OF SYMPTOMS TO MORTALITY

Duration of Symptoms (Days)	Number of Cases	Number of Deaths	Mortality Per Cent
1	19	2	10
2	5	1	20
3	5	1	20
4	2	1	50
5	1	1	100
6	0	0	0
7	2	1	50
7–10	3	2	66
10–14	2	1	50
14–21	3	1	33
21+	1	1	100

surgery performed upon people of such age, and not factors due solely to appendicitis per se. Thus one-third of the deaths were caused by cerebral vascular accidents and pulmonary embolic phenomena; one-sixth of the deaths were caused by operative shock. Thus, in this series, one-half of the deaths were due to operative interference in aged debilitated patients. The other half of the deaths were due to appendicitis or its complications. Three of these deaths were caused by generalized appendicitis, but in each of these cases generalized peritonitis had been present at the time of operation. In no case did it develop subsequent to operation. Pneumonia and cardiac failure, in these aged people in this series, did not constitute a serious mortality factor, probably in part because of the constant prophylaxis against them.

Table III

CAUSES OF DEATH

General peritonitis	3
Operative shock	2
Pulmonary embolus	2
Cerebral vascular accident	2
Mechanical intestinal obstruction	1
Pneumonia	1
Gangrene of cecum and abdominal wall	1
	12
Mortality	28 per cent

Table IV

PREOPERATIVE DIAGNOSIS

Appendicitis	27
Carcinoma of intestine	7
Intestinal obstruction	4
Mesentery thrombosis	1
Generalized peritonitis	1
Diverticulitis	1
Strangulated hernia	1
Acute pancreatitis	1
	43
Per cent of correct diagnoses	62

SUMMARY AND CONCLUSIONS

Appendicitis in the aged occurs with sufficient frequency and obscurity to warrant the suspicion of its presence in any intra-abdominal pathology.

The clinical manifestations of acute appendicitis in these patients were atypical in about one-half of the cases.

Crampy, abdominal pain, distention, and a history of increasing constipation may so closely simulate the picture of intestinal obstruction and carcinoma that operative interference may be unnecessarily postponed.

Eighty per cent of the cases coming to operation showed severe and extensive inflammatory disease of the appendix, and to a lesser degree the cecum and surrounding peritoneum. The tendency toward chronicity is marked, and over one-half of the cases had appendicial abscesses.

There was frequently little correlation between the severity of the disease and the apparent degree of malaise.

The mortality in this group of cases was 28 per cent. One-half of the deaths were caused by operative complications in the aged; the other half were caused by complications due to appendicitis per se.

REFERENCES

1. Aschoff, L. Pathologische Anatomie. Leipzig, 1921. Vol. 1: 505, 506.
2. Beekman, F., Smith, M. K., and Everingham, S. *Am. J. M. Sc.*, 154: 490–500, 1917.
3. Gatewood. *Surg. Clin. N. America*, 10: 303–307, 1930.
4. Huntington, G. S. Quoted by Walton Martin. Dean Lewis' Practice of Surgery, Vol. 1: Chap. 10, p. 68.
5. Lewin, J. *Brit. J. Surg.*, 19: 63–67, 1931.
6. Maes, U., Boyce, F. F., and McFetridge, E. M. *Surg. Gynec. Obst.*, 58: 32, 1934.
7. Swarn, B. R., and Fitzgibbon, G. M. *Brit. J. Surg.*, 19: 410–414, 1932.

RECOVERY FROM INFANTILE PARALYSIS DURING THE FIRST YEAR

ANALYSIS OF CASES FROM THE 1931 NEW YORK EPIDEMIC*

S. PERRY ROGERS, M.D.

SAN JUAN, PORTO RICO

TWO hundred and eighty-two cases of anterior poliomyelitis from the 1931 epidemic in the New York area were seen at the Hospital for Ruptured and Crippled during the first year of their paralysis. Sex distribution shows 156, or 55.3 per cent, males and 126, or 44.7 per cent, females. Age incidence (Chart 1) shows a gradual increase from four months to a peak at two to three years and a gradual remission to about puberty, with the oldest patient at thirty-five years. In 260 cases in which the date of onset was recorded (Chart 2), the peak is shown to have occurred in August.

DISTRIBUTION OF PARALYSIS

Analysis of distribution in parts of the body affected (Table 1) shows the lower extremities affected about twice as frequently as the upper extremities or the trunk, with no significant variation between the two sides. Analysis of cases in which a single part was affected (Table II) shows an even greater preponderance of lower extremities, again with little difference between left and right. Table III shows the relative frequency of the possible combinations in involvement of multiple extremities. Table IV shows the combinations of peripheral involvement associated with paralysis of the trunk. Tables I–IV cover the total 282 cases, and represent both total and partial paralysis.

TABLE I

DISTRIBUTION OF PARALYSIS BY PARTS

Right lower extremity	165
Left lower extremity	162
Trunk	83
Left upper extremity	77
Right upper extremity	76
Neck	26
Face	10
Pharynx	3

TABLE II

PARALYSIS OF SINGLE PARTS

Right lower extremity	50
Left lower extremity	48
Right upper extremity	17
Left upper extremity	16
Face	3
Trunk	2
Pharynx	1

TABLE III

DISTRIBUTION IN INVOLVEMENT OF MULTIPLE EXTREMITIES

Both lower extremities	51
All extremities	36
Both lower and one upper	15
Both upper	5
Both upper and one lower	4
Left upper and left lower	4
Left upper and right lower	4
Right upper and right lower	3
Right upper and left lower	3

TABLE IV

EXTREMITIES ASSOCIATED WITH PARALYSIS OF THE TRUNK

All extremities	32
Both lower	25
Both lower and one upper	11
One lower	7
Both upper	2
Both upper and one lower	2
One upper and one lower	1
One upper	1

The average time elapsing between the onset of the acute illness and the appearance of the patient at this hospital, as estimated from the 260 cases in which the date of onset was ascertained, was 83.3 days. Of the 277 paralytic cases, 250 had sufficiently detailed examinations

* From the Hospital for Ruptured and Crippled, N. Y.

TABLE V
UPPER EXTREMITY PARALYSIS OF MUSCLES IN ORDER OF RELATIVE FREQUENCY

Muscle	*Complete*	*Partial*	*Total*
Deltoid	49	61	110
Triceps	30	55	85
Biceps	17	57	74
Pectorals	21	42	63
Opponens pollicis	23	37	60
Supraspinatus and infraspinatus	22	38	60
Trapezius	12	48	60
Latissimus dorsi	20	39	59
Abductor pollicis	20	39	59
Rhomboids	13	44	57
Serratus anterior	10	47	57
Pronators	12	44	56
Flexor carpi ulnaris	9	47	56
Flexor carpi radialis	8	48	56
Thumb extensors	8	48	56
Dorsal interossei	13	43	56
Palmar interossei	12	43	55
Finger extensors	10	45	55
Lumbricales	10	44	54
Supinators	12	41	53
Extensor carpi radialis	8	45	53
Thumb flexors	5	47	52
Extensor carpi ulnaris	7	45	52
Flexor profundus dig	1	50	51
Flexor sublimus dig	0	51	51

TABLE VI
TRUNK, NECK AND FACE PARALYSIS OF MUSCLES IN ORDER OF RELATIVE FREQUENCY

Muscle	*Complete*	*Partial*	*Total*
Obliquus abdominis	10	63	73
Rectus abdominis	8	65	73
Erector spinae	5	38	43
Neck, anterior	0	17	17
Neck, posterior	0	15	15
Face, mouth	1	9	10
Face, orbit	1	5	6

to be used in a tabulation of complete and partial paralysis of individual muscles. In 232 of these cases in which the date of onset was ascertained the average time elapsing between onset and detailed examination was 97.3 days. Tables V–VII show the frequency of paralysis of individual muscles, complete, partial, and total, arranged in order to frequency of affection.

Table VIII shows the ratio of complete to partial paralysis in the upper extremities, the trunk, neck and face, and the lower extremities. It should be noted that in tabulating paralyses of the neck, abdominal

TABLE VII
LOWER EXTREMITY PARALYSIS OF MUSCLES IN ORDER OF RELATIVE FREQUENCY

Muscle	*Complete*	*Partial*	*Total*
Tibialis anterior	135	114	249
Tibialis posterior	123	109	232
Peroneals	122	102	224
Gastrocnemius	104	116	220
Quadriceps	85	124	209
Extensor longus digitorum	97	111	208
Extensor hallucis longus	98	110	208
Gluteus medius, minimus	70	132	202
Biceps femoris	95	107	202
Flexor hallucis longus	53	148	201
Short toe flexors	45	155	200
Flexor digitorum longus	55	144	199
Inner hamstrings	90	103	193
Hip flexors	61	125	186
Gluteus maximus	64	121	185
Hip adductors	76	103	179
Tensor fasciae latae	50	124	174

TABLE VIII
RATIO OF COMPLETE TO PARTIAL PARALYSES

Part	*Complete*	*Partial*	*Ratio*
Lower extremity	1423	2048	1:1.4
Upper extremity	352	1147	1:3.3
Trunk, neck, face	25	212	1:8.5
Total	1800	3407	1:1.9

and back muscles bilateral paralysis was counted as one paralysis. Doubling these numbers would affect the total number of paralyses but not the ratio of complete to partial paralyses.

SCOLIOSIS

Sixteen cases of scoliosis were noted in the entire series. In 13 cases deformity developed in patients previously under observation at an average of six and one-half months after the onset of the disease. In 3 more patients in whom scoliosis was

noted at the first examination the average time interval was the same. In 3 cases curvature developed in patients still confined to bed and in one case it was observed two weeks after beginning to sit up.

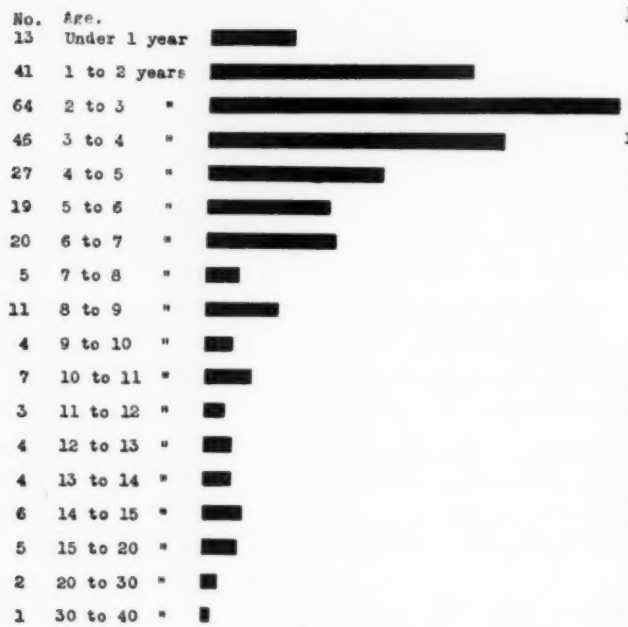


Chart 1. Age at onset.

In 14, or 87.5 per cent, of the cases the first deformity noted was a total curve with its apex at about the dorsolumbar junction. Curvature was to the left in 10 cases and to the right in 4. There were associated paralyses of extremities in every case and of the neck in 2 cases. With the 14 total curves, all extremities were affected in 4 cases, one upper and both lower in 6 cases, both upper and one lower in one case, and both lower extremities in 3 cases. Physical examination showed greater weakness of the abdominal muscles on the same side as the curve in 10 cases and on the opposite side in none. The associated involvement of the extremities was greater on the same side in 9 cases and on the opposite side in 3. Back muscles were too weak to extend the spine against gravity in only 2 cases and in none was any difference demonstrated on the two sides. Four of these patients later developed double curves, always with the lumbar curve on the same side as the original total curve and the dorsal curve to the opposite side.

One case showed a right lumbar, left dorsal curve at the first examination eight months after paralysis. This patient had both lower extremities affected, the right more extensively than the left, and the right abdominal muscles were weaker than the left. One case developed a right dorsal curve five months after paralysis. This patient had paralysis of the left shoulder girdle, normal abdominal muscles, and erector spinae weak but apparently equal on the two sides.

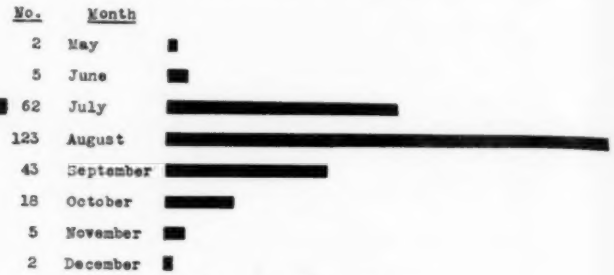


Chart 2. Date of onset.

Of the 13 cases of scoliosis still under observation at the end of the one year period, 2 patients have recovered, 9 have had the progress of their deformity apparently arrested by supporting apparatus, and 2 have progressed in spite of treatment. One of these is a dorsolumbar curve associated with paralysis of both shoulders and in which the dorsal element is the more severe, and the other is a total curve in a patient very severely paralyzed in all extremities, trunk and neck.

TREATMENT

Seventy-two, or 25.5 per cent, of the patients were hospitalized for an average period of 66.6 days. One hundred and twenty-three, or 43.7 per cent, of the patients were immobilized for an average period of 72.4 days. Immobilization here includes solid plaster cases, plaster and other splints from which the patient may be removed for physiotherapy, and Bradford frames for paralyses of the trunk and neck. Braces were applied in 146, or 51.8

per cent, of the cases at an average of 139.1 days after paralysis. Of these 106 patients, or 72.2 per cent, were wearing braces at the end of the one year period, 22, or 15.1 per cent, had discarded braces, and 18, or 12.7 per cent, were no longer under observation.

One hundred and twenty-five of the 282 patients received physiotherapy. Seventy-three, or 25.9 per cent, of all patients began receiving heat and massage at an average of 89.7 days after the onset of their disease and received an average of 46.5 treatments. Sixty nine, or 24.5 per cent of all patients began under-water exercise at an average of 124.9 days after their acute illness and received an average of 40.7 treatments each. Seventeen patients received both heat and massage and under-water exercise.

COURSE

One hundred and sixty-three patients were still under treatment at the end of one year. Of these, 108, or 66.3 per cent, were wearing braces, 20, or 12.3 per cent, had discarded braces, 33, or 20.2 per cent, had never required braces, and 2, or 1.2 per cent, were so severely paralyzed as not to be able to use braces. Seventy six, or 46.6 per cent, had total paralysis of one or more muscles. The muscles totally paralyzed at the end of one year are listed in order of relative frequency in Charts 3 and 4 for the upper and lower extremities respectively. No complete paralyses of the trunk, neck, or face had persisted. To demonstrate the difference in rate of recovery of different muscles, the numbers of total paralyses recorded at the first complete examination of 250 patients, as shown in Tables v and vii, were transposed to parallel columns in these charts. Properly integrated with regard to the greater number of paralyses at the first examination, the relative frequency of total paralysis is graphically represented at the right, the open lines representing frequency of paralysis at the first examination and the solid lines frequency of paralysis at the end of one year.

The larger variations in these graphs taken together with some clinical observations yield important information on the rate of recovery in different muscles. The deltoid in this series showed a very good percentage of recovery. Deltoids were universally well treated by immobilization with the arm in abduction and protection by abduction splints. No case of return of power to a completely paralyzed opponens pollicis was observed. Neither was any careful maintenance of the thumb in the opposed position observed. In general the muscles of the shoulder girdle and arm recovered better than the muscles of the forearm and hand. The intrinsic muscles of the hand recovered least of all. In the lower extremity the anterior tibial was most frequently paralyzed and the tensor fasciae the least frequently paralyzed in both groups. In general the muscles of the hip and thigh recovered better than the muscles of the leg and foot. The dorsiflexors of the foot recovered least of all.

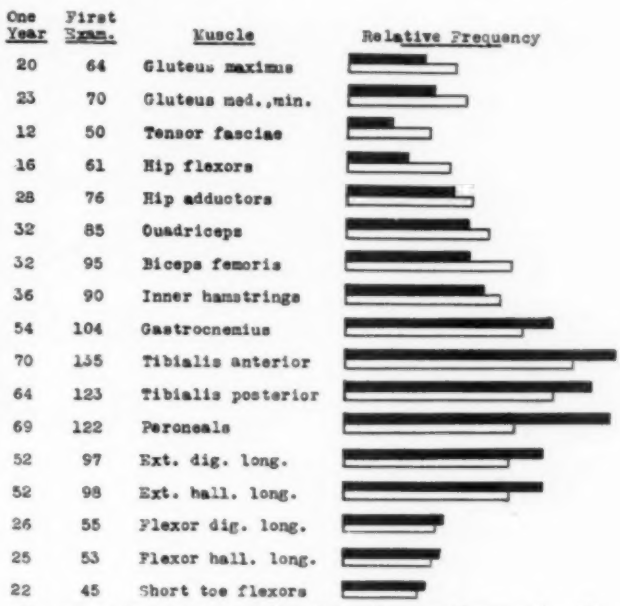


Chart 3. Lower extremity. Muscles totally paralyzed at end of one year (163 cases) compared with those at first examination (250 cases). Relative frequency (solid line, one year; open line, first examination).

The record includes a small number of definite regressions in the dorsiflexors of the foot in ambulatory patients. Four

anterior tibials, two posterior tibials, one peroneal, one extensor digitorum longus, and one extensor proprius hallucis, in 4

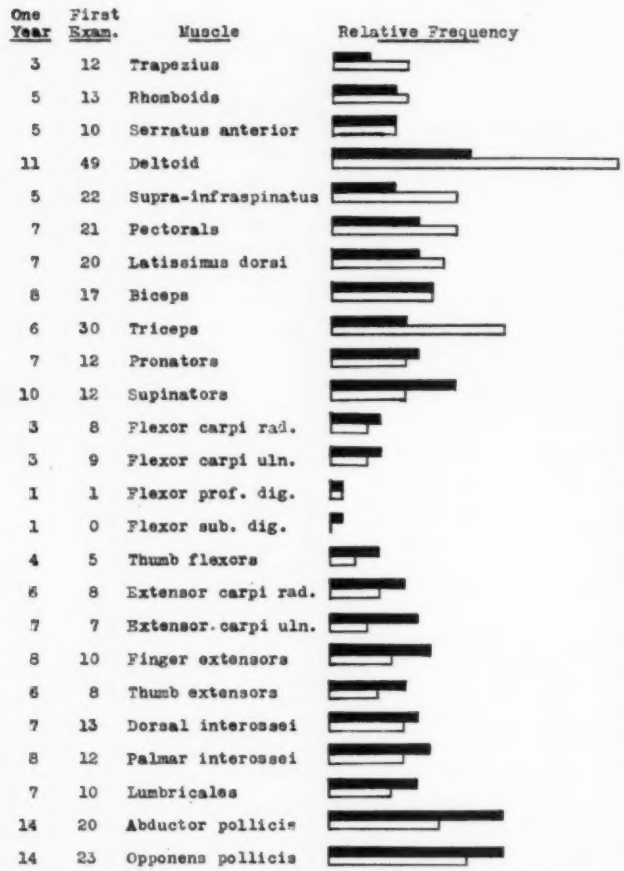


CHART 4. Upper extremity. Muscles totally paralyzed at end of one year (163 cases) compared with those at first examination (250 cases). Relative frequency (solid line, one year; open line, first examination).

patients, regressed from fair power to no demonstrable power. In each case the foot was immobilized for an average period of about one month, when power was re-established and walking in braces resumed.

Sixty-nine patients having paralysis of one lower extremity were carefully measured at the end of the one year period for atrophy and shortening. Only 15, or 21.7 per cent, had any demonstrable shortening, and no patient had more than 1 cm. shortening. The average shortening was 0.17 cm., average atrophy of thigh 2.5 cm., and average atrophy of calf 2.3 cm.

RATE OF RECOVERY

One of the objects of this study was an evaluation of the rate of recovery under the different methods of treatment employed by the three orthopedic divisions of this hospital. It was found, for instance, that the first division had immobilized nearly twice as many of their patients as the second division, and for a period nearly twice as long; that the first division had referred twice as many of their patients for under-water exercises as for heat and massage, while the second division had sent more patients for heat and massage than to the pool; and that second division patients received ambulatory braces on an average of fifty-one days sooner than those on the first division. The third division had comparatively few cases but had many more than their proportionate share of severely paralyzed patients transferred direct from contagion hospitals in the city. In spite of these apparent differences no very pronounced contrasts in the rate of recovery could be demonstrated, partly because of the small number of cases in which muscle examinations were made early enough and completely enough for detailed comparison.

In attempting to record rate of recovery accurately, a schedule was made up in which the muscular power of the body was divided into one hundred parts, 20 per cent for each extremity 20 per cent for the face, neck, and trunk. The upper extremity was divided into 4 per cent each for the shoulder girdle, the shoulder, the elbow, the wrist and the hand. The lower extremity was divided into 7 per cent for the hip, 6 for the knee, and 7 for the ankle and foot. The face was rated at 4 per cent, the neck at 4, the abdomen at 6 and the back at 6. Further subdivisions were made into individual muscles on the basis of functional importance.

Muscles were tested only by functional examination. Records were kept by the letter method: T = trace, P = poor, F = fair, G = good, and N = normal, the first four letters corresponding to 1, 2, 3, and 4 in the numerical method, F or 3 being that power sufficient to overcome gravity. In com-

puting percentages of total muscle power the five letters were interpreted as 20, 40, 60, 80, and 100 per cent of normal power for that muscle. Examinations were made at about monthly intervals and during the last eight months nearly all of them were made by the same individual.

Eighty-three cases were analyzed in complete detail. These are arranged in Table IX, by divisions, with differences in treatment noted. Among the various factors affecting these comparative figures one is important enough to be specially noted: that patients immobilized in circular plaster cases for long periods cannot receive early complete detailed examination, so that any recovery which may have taken place during the period of immobilization was lost to this analysis. The total on all divisions showed an average of 73.8 per cent muscle power at the first examination made at an average of 75.4 days after paralysis, which improved to an average of 84.4 per cent muscle power at the end of one year, an average recovery of 40.5 per cent.

TABLE IX

RECOVERY DURING FIRST YEAR DETAILED ANALYSIS OF 83 CASES

Division	*No. of Cases*	*Average Age (Years)*	*Average No. Days till Seen*	*Average No. Days till Exam.*	*Average Days in Hospital*	*Average No. Days till Braces*
First	26	5.5	49.4	92.8	30.5	150.7
Second	46	3.8	42.8	65.1	14.1	90.1
Third	11	5.4	27.6	67.6	94.7	91.5
Total	83	4.6	42.9	75.4	29.9	115.5

Div.	*Heat and Massage*			*Under-water Exercise*		
	Per Cent Treated	*Days till Treated*	*Number of Treatments*	*Per Cent Treated*	*Days till Treated*	*Number of Treatments*
1	19.2	158.6	35.0	46.2	116.6	53.6
2	52.2	67.5	54.7	43.5	101.7	50.6
3	45.5	75.6	56.6	63.6	63.0	49.6
T	41.0	81.8	51.5	46.0	46.0	51.3

Div.	*Total Muscle Power*			*Per Cent Recovery*	*One Lower Extremity*			
	First Exam. (Per Cent)	*One Year (Per Cent)*	*Increase during Year (Per Cent)*		*No. of Cases*	*Shortening (cm.)*	*Atrophy Thigh (cm.)*	*Atrophy Calf (cm.)*
1	76.2	85.4	9.2	30.2	11	.18	2.7	2.3
2	75.7	86.4	10.7	44.0	20	.22	2.9	2.4
3	60.1	73.9	13.8	34.6	1	.00	6.0	3.0
T	73.8	84.4	10.6	40.5	32	.20	2.9	2.4

COMPLETE DISLOCATION OF THE KNEE JOINT*

CHESTER E. STELLHORN, M.D.

BROOKLYN, N. Y.

COMPLETE dislocation of the knee joint is a rare lesion, subluxations are fairly common. The rarity of the condition is attested by the sporadic reports of isolated cases, by the admission of several eminent surgeons who discussed Weigel's case[1] and by Ritter's[2] failure to find a single case among 23,000 accident cases at the Reconstruction Hospital and finding but 3 cases in the records of the New York Post Graduate Hospital. The case here reported is the only one seen in the past ten years at the Cumberland Hospital, on a very active traumatic service.

ETIOLOGY

Congenital dislocation has been described.[3] Dislocations, seldom complete, occur in suppurative and other arthritides, tuberculosis and in poliomyelitis. Direct or indirect violence is the usual cause. A sudden force applied directly to the leg may dislocate the tibia, if against the thigh may dislocate the femur. Indirect forces may act by hyperextension or rotation while the thigh or leg is fixed, as in falling forward after stepping in a hole, by the impact of a fall from a height, by twisting the leg caught in moving machinery or in automobile or train accidents where the leg is caught in wreckage and the body carried in some direction by inertia.

TYPES

The dislocation may be anterior, posterior, outward, inward or rotary. The direction is determined by the relation of the *tibia* to the femur. The pathology is mainly an extensive laceration of the capsule and of the various ligaments which normally maintain the stability of the knee joint. The dislocation may be complete or incomplete, simple or compound. Injury to adjacent tissues may complicate the luxation. Any type may have an associated fracture of tibia or femur. Hemarthrosis is common, the hamstring tendons may be avulsed, the semilunar cartilages fractured or displaced, the popliteal vessels and nerves[4] may be injured. Severance or avulsion of the crucial ligaments is a frequent occurrence.

Dislocation outward is usually incomplete. The medial condyle of the tibia is in relation to the lateral condyle of the femur, the latter is usually fractured. The lateral condyle of the tibia and the head of the fibula are prominent laterally. Shortening is infrequent.

Internal dislocation presents the lateral condyle of the tibia in relation to the medial condyle of the femur. It is usually incomplete, the external peroneal nerve may be injured.

Posterior Dislocation. The tibia projects posteriorly and the condyles of the femur anteriorly. If complete there is usually overriding and hence shortening.

Anterior dislocation is the most common type. The condyles of the tibia are anterior and the femur posterior. Overriding and shortening usually occur. The patella is freely movable and may be displaced.

Rotary dislocation may occur alone or in association with any of the other types.

DIAGNOSIS

There is seldom much difficulty in diagnosing the complete types, the structures are so large that the cause of the deformity is obvious. Roentgenograms should always

* From the Department of Surgery, Cumberland Hospital, Brooklyn, N. Y., Dr. John E. Jennings, Director.

be taken in anteroposterior and lateral views. They are of distinct aid in the recognition of subluxation and in detecting associated fractures.

TREATMENT

Simple dislocation, seen shortly after the injury, should be reduced immediately under general anesthesia. Traction on the leg, countertraction on the thigh and pressure on the condyles in a direction appropriate to the type of dislocation will effect a reduction. If there is much hemorrhage into the joint, it may be aspirated. Complete extension should be maintained by a tubular plaster-of-Paris bandage for four to five weeks. After two weeks the splint may be bivalved and massage, passive and later active motion may be instituted. A long leg brace with lockable knee joint may be fitted when the splint is discarded and weight-bearing allowed. It should be worn for several months. Compound dislocation, extensive soft tissue injury or cases in which the popliteal vessels are greatly damaged may require debridement, repair or even amputation. Associated fractures should be reduced when necessary. Open reduction or arthrodesis is seldom necessary except in old neglected cases. For the residual instability of the joint, which will occasionally be seen, repair of the crucial ligaments[5] or lateral ligaments with fascia lata, may be indicated.

PROGNOSIS

Dislocations without serious complications, if reduced early will have excellent end-results, far better than might be expected. In extensive or compound injury a mid-thigh amputation may be necessary. Residual instability or limitation of motion occasionally occurs. Sacrifice of the joint by arthrodesis will sometimes be necessary.

CASE REPORT

Mr. J. M., aged fifty-four, an American clerk, entered the dispensary of the Long Island College Hospital on October 17, 1931, complaining of instability of the right knee. He had wrenched the knee a few weeks previously and since then had difficulty in walking, with moderate swelling and slight pain in the knee. His past history included an admission of chronic alcoholism and a Neisserian infection. No history of chancre or antiluetic treatment; he was in fair general health and his mentality appeared normal.

Examination showed a definite swelling about the right knee with increase in the joint fluid. There was a full range of flexion and extension with some coarse crepitus on motion. There was some hypermotility of the knee in all directions. The lower extremities were of equal length. Slight instability of the other knee was noted.

An *x*-ray of the knee showed slight anterior subluxation and an increase in the joint fluid; the bony outlines were clear and distinct, there was no bony atrophy, fragmentation or hypertrophic arthritic change. The blood Wassermann was negative.

A long leg brace with caliper at the heel and without a knee joint was advised and fitted to the patient. Operation was not recommended. The patient did not return for further observation or treatment.

On June 12, 1933, the patient entered the Cumberland Hospital, service of Dr. Chester Davidson, complaining of difficulty in walking, due to trouble with the right knee, and shortening of the right leg. Considerable mental and physical deterioration was evident. He had difficulty in remembering the date of onset and course of his illness. He did not recall any recent, additional injury to the knee. During the past few months the swelling of the knee had increased, the leg had become much shorter than the left and he had become very "nervous." He had continued to wear the brace, had remained at home applying rubbing alcohol and hot towels to the knee and administering whiskey internally. His past history and family history did not reveal any additional information pertinent to his illness.

Physical examination showed a grey haired, underdeveloped and undernourished male. The flush areas of the face showed telangiectasis, acneiform lesions and permanent hyperemia. The pupils reacted sluggishly to light, there were many carious teeth, the pharynx was injected and the tongue dry and coated. Examination of heart, lungs and

abdomen was essentially negative. He walked with an unsteady gait but without pain. The right lower extremity was 4 inches shorter than the left. The region of the right knee was greatly enlarged and grossly deformed. The condyles of the femur were palpable posterior to the tibia and lying upon the tendons of the hamstrings. The knee could not be flexed or extended; considerable telescoping of the knee was possible by alternate traction and release of the leg. Nearly 180° of rotation of the *leg* was possible. The region of the knee was not tender, there was no pain on manipulation. Patellar tendon reflexes were absent bilaterally. There was some instability of the left knee.

Laboratory data: W.B.C. 5400; P. 76 per cent; R.B.C. 4.9 million; Hb. 70 per cent. Urine analysis showed nothing of importance. Blood and spinal fluid Wassermann reactions were negative. Coagulation time five minutes. B.P. 130/70. Temperature and pulse were normal.

An *x*-ray showed complete anterior dislocation of the right knee. An irregularly calcified mass was noted arising from the medial condyle of the femur. (See Fig. 1.)

The patient was kept in bed for two weeks and observed. He did not develop delirium tremens and his general health and appearance improved somewhat during the interval. He begged to have an operation on the knee and it was decided to perform an open reduction and an arthrodesis.

On June 26 the knee was opened by a transverse incision under ether anesthesia. The

FIG. 1.

distal end of the femur was withdrawn from its abnormal position with considerable difficulty, disclosing a newly formed joint cavity having the gastrocnemius muscle and tendons of the hamstrings as its base and completely lined with synovial membrane. The articular cartilages of femur and tibia were intact, the semilunar cartilages were torn and frayed and the cruciate ligaments were completely severed. Adhesions and soft tissue contractures prevented complete reduction of the overriding so that a considerable portion of the distal end of the femur was resected to permit complete extension in reduction. The articular cartilage of the tibia was removed. Fixation of the position of tibia and femur was secured by passing a Kirschner wire through the ends of the bones and twisting the wire ends together. The incision was closed and a long leg plaster-of-Paris bandage applied in complete extension.

The patient ran a moderate fever for a few days after the operation, his temperature fell nearly to normal thereafter and he seemed to be getting along well. The circulation and motor function of the right toes were unimpaired. On the ninth day postoperative the patient suddenly became cyanotic, cold and clammy, with rapid, almost imperceptible

pulse. Stimulants were given but he died within a few minutes. Permission for autopsy was not granted.

COMMENT

It seems likely that the original injury sustained by the patient was a tearing of the crucial ligaments, resulting in an unstable hypermobile joint. Some slight additional injury, perhaps occurring while the patient was intoxicated, might have converted the subluxation into a complete dislocation. Charcot knee is unlikely in this patient, the *x*-ray appearance, negative history and repeated negative serology exclude that diagnosis beyond reasonable doubt. The absent knee jerks, sluggish reaction of pupils to light, unsteady gait, acne rosacea and mild Korsakoff psychosis were undoubtedly due to chronic alcoholism.

In retrospect, it would seem that a longer period of rest, with traction to reduce the overriding and dislocation might have simplified the operative procedure. He did not appear to be a poor surgical risk and the terminal picture, which has all the earmarks of a pulmonary embolism, was unpredictable.

The author wishes to thank Dr. Chester Davidson for permission to report this case.

REFERENCES

1. Weigel, A. W. Am. J. Surg., n.s. 9: 140–141 (July) 1930.
2. Ritter, H. H. *J. Bone & Joint Surg.*, 14: 391–394 (April) 1932.
3. Hofmann, S. *J. Bone & Joint Surg.*, 12: 871–875 (Oct.) 1930.
4. Patterson, R. H. *Ann. Surg.*, 99: 521–523 (March) 1934.
5. Cubbins, W. R. *Surg. Gynec. Obst.*, 54: 299–306 (Feb. 15) 1932.

USES OF THE

"U" OR "SUGAR-TONG" MOULDED PLASTER SPLINT

EUGENE L. JEWETT, M.D.

NEW YORK CITY

THIS paper proposes to offer nothing new, but only to discuss in more or less detail, a certain type of plaster splintage. The moulded plaster "U" splint is familiar to all who carry on a fracture practice to any extent. But it is with the thought that all are not cognizant of the wide range of its usefulness and applicability that I enter on this short discussion.

These splints are made in the usual manner of either 3 inch or 5 inch wide plaster-of-Paris bandage. It is better to use the plain dental plaster with nothing added to it, which results in a setting time of from four to five minutes. The average thickness of the splint is six to eight layers, but at times as many as twelve will be necessary. A strip of Canton flannel, somewhat wider than the splint, is placed on the skin side of the plaster with the free edges turned over onto the back. This makes a neat, smooth-edged splint, and is generally the only padding that is used. Careful moulding of the splint to the underlying limb is very important, as inexact application gives rise to pressure and discomfort later on. The gauze bandage first applied to hold the splints in place as they harden is usually best replaced before the patient goes home or into a hospital bed by one a little looser, more carefully applied. Spirally wound adhesive tape is obviously best applied, after the post-reduction *x*-ray plates have been taken.

Frequently this type of splint can be used in place of a circular cast with equal immobilization certainty; that is, barring unusual accidents to the limb. One of the most important advantages to be gained from the use of the splint is in the relief of post-reduction swelling from a too tight encasement. A patient of the average intelligence who would need hospital observation for a day or so with a cast on a limb, can safely be sent home with a moulded "U" splint. The ease of adjustment of the ordinary anterior and posterior splints applies to this type. The patient is warned of the changes to be noticed in the toes and foot arising from circulatory impairment and can be trusted with some degree of self-loosening of the bandage. Generally, an inch or two cut of the bandage on the dorsum of the foot or ankle will relieve the pressure enough and will not interfere with the retention of reduction. If the swelling necessitates returning to the hospital or doctor's office, the bandage can be removed easily, and a looser one applied very much easier than a cast can be bivalved. A cast that is bivalved immediately after application is about as easy to readjust as the splint, but it cannot be coaptated to the varying size of the encased limb to any such extent as can the moulded splint. Another important advantage of the splint over the cast is its lightness. This is an important consideration when the limb must be splinted to the middle or upper part of the thigh. Also, of course, the amount of plaster is correspondingly decreased with a saving to the patient in the cost of this plaster.

The "sugar-tong" splint of Cole is mentioned by Ware in 1906 in connection with fractures of the forearm. This splint is very useful in certain Colles' and other wrist fractures also. The splint is made similar to any forearm splint, but is long and usually made from the 3-inch plaster rolls. It extends from the palm up on the flexor surface of the forearm around the

elbow and lowest end of the humerus and back to the fingers on the dorsum or extensor surface of the forearm and hand. Of course, the reduced fragments of bone must be held in good position during this application. In making the turn around the elbow there must be some rotation or twisting of the splint, especially with the arm held in supination. The splint must then be carefully moulded to the limb and fastened with a gauze bandage.

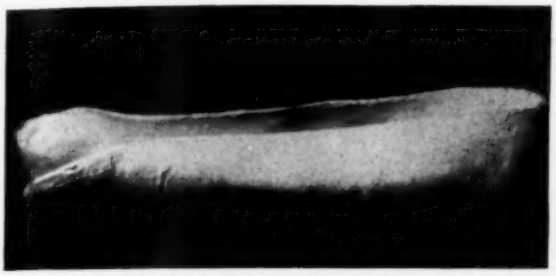


Fig. 1A. Sugar-tong splint for forearm.

Another use of this type of splint is in fractures of the humerus, where an ambulatory light support is needed. Such an instance is seen in a fracture of the humerus which has been treated in either traction and suspension or a shoulder spica and has reached the stage of lead-pipe union, or in an impacted fracture of the neck of the humerus in an elderly person. These and other conditions can well be taken care of by a sugar-tong splint that goes from the anterior surface of the arm up over the shoulder and down the posterior aspect of the involved member. Generally, the splint runs to the fingers with the arm held in 90 degrees flexion at the elbow. Then one of the further supporting devices such as a sling, axillary triangle or light aeroplane splint may be employed. The shoulder must be padded. This splint is shown in Figure 2.

A little more elaborate and effective full arm and shoulder splintage is obtained with the splints shown in Figure 3. Their usefulness is covered by what has already been said and in addition injuries about the shoulder joint may be included. It is important to have the anterior arm splint uppermost so that it can be removed first if this is desired. The plaster must be carefully moulded especially over the back; otherwise the patient will have discomfort when lying down. The shoulder must be sufficiently padded and generally an axillary pad of cotton or sheet wadding is used. A sling helps to support the forearm and the ends of the splints about the body can be fastened with bandage or adhesive tape.

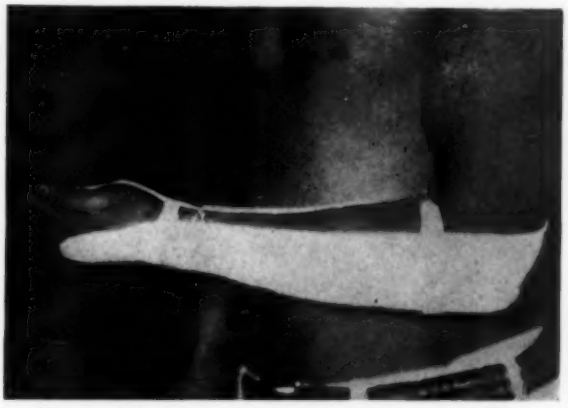


Fig. 1B. Sugar-tong splint for forearm applied. (Adhesive applied for pictures only.)

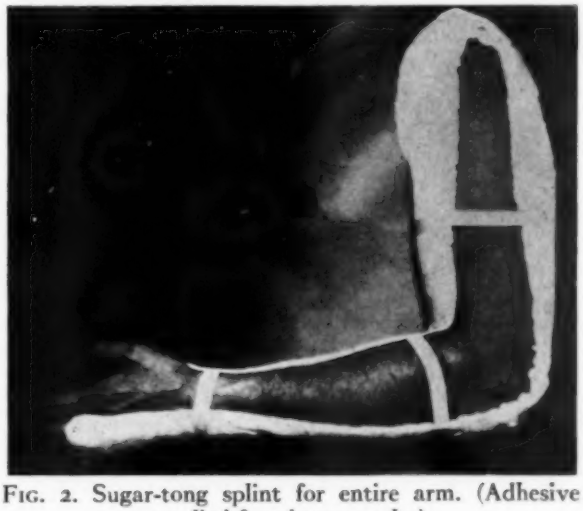


Fig. 2. Sugar-tong splint for entire arm. (Adhesive applied for pictures only.)

It is for fractures of the leg and ankle, however, that the sugar-tong splint is most often used. Most fractures about the ankle joint and lower leg can be well maintained in the reduced position by means of this splintage, with or without a posterior splint. The latter, of course, helps prevent posterior displacement of the foot in the

cases where this is likely to occur. This U splint or the "reconstruction splint," which really is a two-piece U splint, gives staff men in this institution are sure that they originated here. There are certain points to be remembered if the most

FIG. 3A. FIG. 3B.

FIG. 3. A. Sugar-tong splint over arm and chest, anterior view.
B. Sugar-tong splint over arm and chest, posterior view.

added splintage about the foot and ankle, and is our method of choice in most of these injuries, especially those seen early. The advantages of this type of splintage over the circular plaster cast are obvious and the maintenance of reduction is just as effective, if the splints are applied correctly. The sides of the splint usually are carried well up on the thigh with the knee slightly bent, and basswood splints (moistened) are often incorporated in the supporting bandage to reinforce the apparatus. We use either 5 inch or 3 inch plaster of eight or ten thicknesses, depending on the size of the limb and the type of fracture. For fractures in the vicinity of the knee, the 5 inch is generally used with a posterior splint, which extends as high as the lateral splints.

A very useful modification of the U or sugar-tong splint for the leg is a lateral splint which may be used on either side or on both. These splints, as used by us, are somewhat different from and have a definite advantage, we believe, over the usually described lateral splints. These splints have been used in the Reconstruction Hospital for many years, and the older efficient and comfortable immobilization is to be obtained. The ball of the foot, at least as high as the distal ends of the metatarsals, must be supported. Also it is better to leave a free space on the dorsum of the ankle to allow for swelling and inspection, if necessary. Many fissure fractures of the malleoli or of the fibula alone may safely be put up in one splint, but generally, bilateral splints with or without a posterior one, are advisable. It is generally necessary to cut the anterior borders of the lateral splints in the region of the ankle for a distance of 1 to 2 inches, in order to obtain the correct amount of snugness about the ankle. This applies equally well to the U or sugar-tong splints, especially if the 5 inch plaster is used; likewise in the proper fit of the posterior splint about the heel it is necessary or advisable to cut in a short distance on each side, with the corners either turned over on each other or cut away. Generally both lateral splints, without or with the posterior splint, may be bandaged at the same time, but there is no harm in fastening one first while the other is being made and then applying the other. In such a case it is

better to cut the gauze of the underlying layer before the outer layer is applied, so as to guard against too tight a constriction

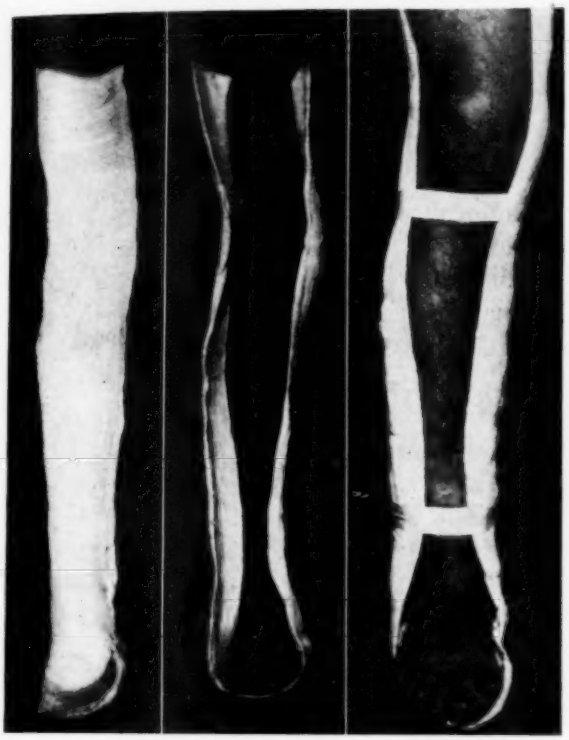


Fig. 4A. Fig. 4B.

Fig. 4A. Posterior and "U" splint for leg. B. Posterior and "U" splint for leg applied.

about the leg. Often a 5 inch wide splint is used on one side and 3 inch on the other. The posterior splint is better if made of the 5 inch width.

We have been very interested in noticing the appearance of blebs in fractures of the lower leg and ankle, with or without immobilization. These have appeared with the applications of casts which were bivalved immediately after being applied; in cases where lateral and posterior splints were applied with bandages loosened for careful inspection of the leg within a few hours; and even in limbs put up in traction and suspension with nothing about the leg whatsoever. Of course, a too tight immobilizing device will naturally cause a greater amount of impairment of circulation, but this is not the sole cause. We have reduced lower leg and Pott's fractures within a half hour of injury, and still blebs appear, where we could not in any manner blame the plaster encasement.

In many of these ankle or leg cases the patient can be up and walking with a

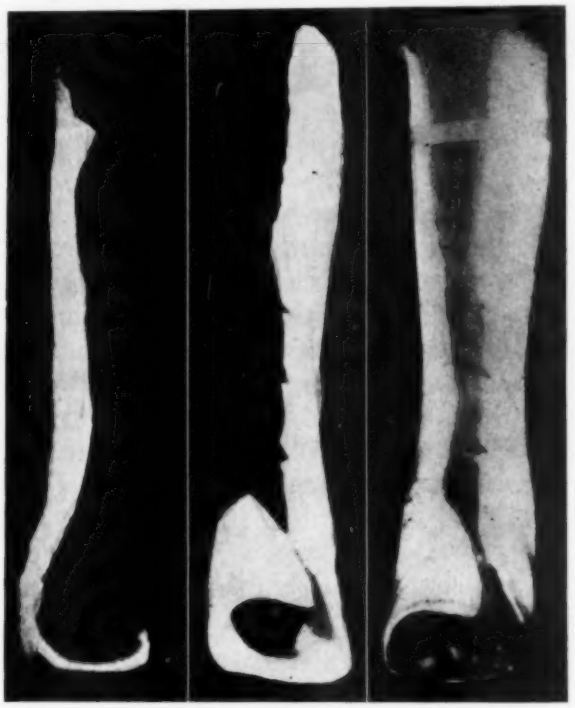


Fig. 5A. Fig. 5B.

Fig. 5A. Reconstruction-lateral splints. B. Reconstruction-lateral splints applied.

walking iron in a few days, which, of course, necessitates a circular plaster cast either to or above the knee. If however, no weight-bearing is to be allowed, walking with crutches is much easier with these splints than with a heavy cast. We have found it much better not to apply a walking cast over the original lateral or U splints as these invariably produce pressure symptoms. We follow the method of applying walking casts which has been popularized and best described by Böhler.

In the last two years at the Reconstruction Hospital Unit of the New York Post-Graduate Medical School and Hospital we have had 110 fractures of either one or both bones of the lower leg. Most of these fractures were of the Pott's variety, although many were of the tibia or fibula or both slightly higher up. Seventeen, or 15 per cent, of the entire series were immobilized after reduction in sugar-tong

[Concluded on page 351.]

SURGERY IN THE DIABETIC*

JOHN F. ERDMANN, M.D., F.A.C.S. WITH HAROLD E. CLARK, M.D., F.A.C.S. AND E. J. BUCKLEY, M.D.

NEW YORK CITY

THE last decade has disclosed a marked change in the attitude of the profession toward surgical intervention in acute surgical conditions in patients suffering with diabetes mellitus. Prior to 1920 the routine procedure was to procrastinate as long as possible in these cases, surgery being attempted only as the last resort. This trepidation, based on poor results, was indulged in by both astute internist and the well-trained surgeon. When surgery was resorted to, the results were appallingly bad, thereby justifying the anti-operative fear of those concerned.

Fortunately this opinion has been completely changed, and we now perform operations upon properly prepared diabetics with as much freedom and composure as upon non-diabetics of similar age groups. The current opinion that diabetes properly treated does not influence operative risk is justified by the reports from reliable clinics.

Judd, Wilder and Adams from the Mayo Clinic concluded that diabetes, controlled, does not increase the risk of operation. In 1930 at this clinic out of 288 operations on diabetics there were 5 deaths. Not one of these was directly attributable to this disease. In 1930, out of 218 operations there were 6 deaths with the same findings. Allan from the Lahey Clinic makes similar observations in which I heartily concur. My attitude toward surgical intervention in diabetes with the present methods of treatment is the same as in non-diabetics. In elective cases an attempt is made to restore metabolic conditions to normal if possible. In emergency cases requiring immediate surgery I have no hesitancy in treating the acute condition and leaving the diabetes in the hands of the internist. To date my results have justified this. Dr. I. I. Lemann, quoted by Maes, has stated that in acute surgical conditions, if diabetes were treated first and the surgical condition secondarily, the illness was apt to be brief, i.e., concluded by a mortality.

The surgeon in diabetes is called upon to treat a specific local condition with which he is more or less familiar, superimposed upon a system disease best treated by the internist. Therefore, dual control is necessary by the surgeon and the internist when confronted with surgery in diabetes.

The factors concerned in the presentation of the surgical aspects of this subject are many and varied and it is impossible at times to avoid invading the realm of the medical man. I have attempted to discuss the problem as a whole and to correlate the surgical picture.

Diabetic patients must resort to surgery more often than non-diabetics. Joslin estimates that 11 to 14 per cent of hospital diabetics require surgery. At the Mayo Clinic about 25 per cent and in 1932 at the Lahey Clinic 34 per cent required surgical intervention. This gives a general idea of the high surgical incidence in diabetics.

Joslin states that from 1923 through 1927, 548 operations yielded a mortality of 9.3 per cent while during the period of 1928–1930, 580 operations with the use of insulin yielded a mortality of 5.9 per cent.[12]

* Read before the Pan American Medical Association.

Unprepared patients, of course, are poorer risks than the prepared. The patient with diabetes of long duration in whom the oil of the skin has been absorbed and the skin is dry, is more prone to infection and union is delayed.

The factors influencing the surgical risk in diabetes are (1) age, (2) susceptibility to infection, (3) delayed healing, (4) acidosis.

AGE

Age probably plays the paramount part in the surgical diabetic risk at the present writing. A large proportion of patients coming to surgery are in the fourth decade with the majority in the fifth or sixth decade. Joslin (1923) estimates that 63 per cent of the surgical patients are fifty years of age or older. He also states that the average age for developing gangrene is sixty-one years. Eliason found the age incidence for gangrene (1926–32) to be 63.5 years. McKittrick and Root advance the age to 64.9 years. Eliason[2] states that insulin has advanced the age of gangrene seven years. Untreated diabetics develop arteriosclerosis by the fortieth year, if not earlier. Associated with this are the concomitant changes of age: slow healing, prolonged convalescence, exhaustion, faulty metabolism and cardiorenal changes. Without diabetes these conditions make for increased surgical risk. Gangrene, carbuncles, gallstones, myocardial failure, uremia, septicemia and pneumonia, are common ailments of elderly people without an associated diabetes. A long-suffering diabetic may be expected to have these conditions in a magnified form. Thus the age factor in diabetes must be assigned an important role in computing operative risks. Joslin feels that these deaths are more medical than surgical and we fully agree. Allen feels that with surgical conditions favorable, the aim should be to prevent vascular and other changes by thorough control of diabetes from the first diagnosis.

SUSCEPTIBILITY TO INFECTION

Infections, which in the non-diabetic are not regarded seriously, are usually alarming in the diabetic. Nowhere do we see such rapid spread of infection in the fascial planes as in the diabetic. When complicated with the appearance of B. coli communi and streptococci, the sugar content is a pabulum for the infective organism. Frequent boils, carbuncles and abscesses demand that diabetes be ruled out. Hyperglycemia, acidosis, poor insulin response and coma are all aggravated by infection. Infection disturbs sugar tolerance in a controlled diabetic. This was well demonstrated recently in a woman whom I saw about two weeks ago.

The patient had all the cardinal evidences of an acute (gangrenous) appendicitis. The polynuclear count was high; temperature 102°; pulse 110. There was exquisite tenderness in the right lower quadrant. The onset of pain was thirty-six hours previous to the time I first saw her. Her attending physician reported that at times there was 1 to 3 per cent sugar in the urine and at the time I saw her the sugar was 5 per cent. An operation was performed one hour later under gas and ether, the latter in a very small quantity. The operative procedure was short. Twenty units of insulin were given as soon as she was placed in bed and from then on the diabetes was taken care of by her medical attendant. Roughly speaking her insulin units varied from 20 during the first twelve hours until the fourth or fifth day postoperative when she was given 10 to 15 units during twenty-four hours. The usual precautions as to urinalysis were taken, the nurses were instructed in the method of making the test with Benedict's solution and a complementary diet outlined by the family physician. Upon operating on this patient we found that the appendix was totally gangrenous and a considerable amount of exudate was wiped out of the ileocecal angle. A drain was used for three days. The recovery in this patient could not have been better in a non-diabetic. At no time have I allowed her to be entirely sugar free (½ to 1 per cent), as I have found that the surgical patients in whom diabetes is of long standing will respond better in all ways, men-

tally and surgically, if a fraction of sugar be retained.

E. W. Saunders explains the severity of infection as probably being due to enhanced growth of glyophilic organisms in the tissue abnormally high in glucose and a hydrogen-ion concentration most favorable to toxin production. Lowering blood sugar with resultant low tissue sugar helps control existing infection.

DELAYED HEALING

Healing in the diabetic is associated with the same factors mentioned under Age. Cardiorenal changes and arteriosclerosis, augmented by hyperglycemia, acidosis and dehydration, play the important part. Debridement frequently has to be resorted to in the treatment of the wounds.

ACIDOSIS

Vomiting in a non-diabetic frequently produces dehydration acidosis, low CO_2, plus acetone and diacetic acid in the urine. With surgery in the diabetic, the glycosuria and hyperglycemia produce polyuria and nausea, increasing the dehydration and the incidence of acidosis. Glycosuria of itself is not important but acidosis in association with it must be checked to prevent coma and a mortality.

INDICATIONS FOR OPERATION

The most frequent surgical complications with diabetes are carbuncles and the gangrene of the feet and legs.

While all ordinary surgical lesions may complicate diabetes we have frequently operated for acute appendicitis, fibroids, cholecystitis, carcinoma of the breast and acute mastitis. I recently operated upon a woman thirty-two years of age for a steatoma of the cheek, who had sugar fluctuating from 0 to 2½ per cent. During the past week I had a man twenty-six years of age who was operated upon for a pilonidal cyst in whom there was a sugar of ½ to 1 per cent.

PREPARATION FOR OPERATION

Management before operation depends upon whether the contemplated surgery is (1) elective or (2) emergency.

Elective Surgery. When there is ample time for preparation and observation of the diabetic in the non-infected cases, complete control is left to the medical staff. Balanced diet is the first consideration and an attempt is made to adjust the diet to the surgical requirements while at the same time rendering the urine sugar and ketone body free. The blood sugar should be reduced below 200 mg. No attempt by fasting is made to secure these results. On the contrary the patient is fed generously and often, up to the time of operation. Easily available carbohydrates are pushed to counteract the liver glycogen loss and to establish an abundant reserve. Orange juice, cereals and milk may be given at frequent intervals. Insulin is given as indicated to combat acidosis and to assure complete metabolic processes. The dosage depends entirely upon the amount necessary to keep the blood sugar within safe limits and to render the urine sugar free. Glucose 50 to 100 gm. may be given immediately preoperatively in the necessary cases, with enough insulin to protect and assure its utilization. Dehydration is combated by forcing fluids 2000–3000 c.c. daily. Oral administration is the rule but where there is any difficulty, hypodermoclyses of saline and glucose 5 per cent, intravenous saline and glucose 10 per cent or 6 oz. rectal taps, consisting of 3 oz. saline and 3 oz. tap water, every four hours, may be resorted to. I do not use the Murphy drip nor do I give glucose by rectum, since I doubt their efficacy.

In the *emergency cases*, when no time is available and the history is unreliable, the urine is examined for sugar, acetone and diacetic acid. If possible, the blood sugar content and the CO_2 combining power are determined. When indicated, glucose 30–50 gm. is given intravenously or by clysis, and insulin is used if necessary, the ratio being

1 unit of insulin to 1.5–2 gm. of carbohydrates. Fluids are forced by all the previously mentioned methods.

The specific treatment preoperatively concerns chiefly the local conditions, namely gangrene of the leg or carbuncles and abscesses, etc.

Dry gangrene is treated conservatively and watched for demarcation. Rigid asepsis is practiced. The part is elevated, kept warm and dry and pressure avoided. By this method I have frequently been able to avoid major surgical intervention. Moist gangrene does not lend itself well to such conservatism, though at times, in the absence of infection, it may be tried. Wet dressings and ointments are rigidly avoided. Asepsis must approach perfection. With infection, lymphangitis or spreading cellulitis, early emergency surgery gives the best result. Eliason estimates 87 per cent of gangrene in diabetes is moist.

At times it is desirable, if operation is refused or considered inadvisable, to use some antiseptic such as an iodine solution for a time. The so-called minor operations are considered more dangerous by me than the major operations as any one attempts to lance carbuncles, amputate toes and open abscesses. It is in these latter cases (toe and leg) that great damage is done by distributing foci of infection up the tendon sheath. Early radical operations should be done when progressing infection signs appear, red lines up the leg, bogginess of the sole and dorsum of the foot and the leg.

ANESTHESIA

I have found spinal anesthesia not a dangerous method to use nor can I say anything adverse to ethylene or gas oxygen. Ether may be used though in small quantities for short anesthetics, for it has been found that ether is likely to produce acidosis and hyperglycemia. I would reject chloroform as a dangerous agent in any type of surgery and surely in a diabetic patient on account of its action upon the liver and almost certain resultant acidosis.

INDICATIONS FOR OPERATION

Joslin[11] gives the following indications for operation to which I now call attention very strongly; a rapidly spreading infection, a virulent infection with signs of sepsis, a severe toxemia, diabetes that can no longer be controlled by insulin and diet.

OPERATION

It is rare in gangrene that one accomplishes a satisfactory result by a foot or lower leg operation. In these patients, the dorsalis pedis, posterior tibial and popliteal arteries are thrombosed, as are usually all the vessels of the leg and lower thigh. Low amputations frequently demand secondary and higher amputations, thereby subjecting the patient to double operative risk. The mortality of the second or higher operation is increased over 15 per cent. (Eliason.[2])

May I call attention to the fact that following operative procedure there will frequently be an associated abatement of the glycosuria; in fact it is not rare to observe after operations for gangrene, sloughs and carbuncles that the sugar content is markedly diminished or disappears.

I prefer above-the-knee operations because of a cleaner field and greater distance from infection, the better possibility of primary union due to collateral circulation and the diminishing of the morbidity and hospitalization period of the patient. Weight-bearing stumps are seldom to be considered in these individuals because of their advanced age. In younger patients this might be debatable. Amputations are usually of the guillotine type, sharp dissection without a tourniquet. The soft structures are approximated over the osseous stump and the wound closed loosely with drainage. When confronted with boils and abscesses, wide early incision is the rule. In small carbuncles it has been my practice to use either the crucial or gridiron incision, depending upon the location and extent of the diseased area. The incision

is carried through the diseased area to healthy tissue. For larger carbuncles excision is done under gas. Gauze soaked in phenol 1 per cent has been found to be the least painful dressing as it is both antiseptic and anesthetic. In abdominal operations the procedure is the same as in the non-diabetic with emphasis on speed and freedom from further trauma. These principles apply to all surgery and particularly in the diabetic.

POSTOPERATIVE CARE

The surgical postoperative treatment consists of constant observation of the sugar content in the urine and an occasional check-up on the blood content. Much depends on preoperative standardization.

The fresh urine is tested in Benedict's solution the nurse having been instructed in interpreting the reaction. Slight reduction with a green color indicates about 1 per cent glycosuria and calls for about 5 to 10 units of insulin daily; medium reduction, with a yellow or brown color indicates 1–5 per cent glycosuria and calls for 10 to 15 units daily; marked reduction with a red or orange color indicates 5 per cent glycosuria, and calls for 15 to 20 units daily. Presence of acetone and diacetic acid calls for 20 or more units daily.

All specimens are examined for glucose, acetone and diacetic acid during the first forty-eight hours; thereafter three or four times daily, before meals, as indicated.

A blood sugar and CO_2 determination is made immediately after operation and repeated when necessary.

Fluids are forced by mouth, rectum, hypodermoclysis or vein, up to 2000 to 3000 c.c. daily. The patient is encouraged to take fluids by mouth as soon as possible —sweetened drinks, oatmeal, orange juice and milk. A return to normal maintenance diet is sought. When necessary glucose may be given up to 50 gm. daily, subcutaneously or by vein, during the first forty-eight hours.

The dosage of insulin is determined by the preoperative requirement and standardization and the postoperative urine and blood findings.

PROGNOSIS

In the carefully prepared diabetic patient with optimum surgical skill and medical care, the prognosis is the same as in the non-diabetic of similar general virility. Death is due as much to arteriosclerosis, gangrene, myocarditis and exhaustion as to diabetes per se.

A hospital mortality of between 5 and 10 per cent may be expected in all surgical diabetics. In amputations below the knee, Eliason gives a mortality of 56 per cent, in mid-thigh amputations a mortality of 55.8 per cent. Secondary operations on low amputations give an increase in mortality of 15 per cent. Forty-two per cent of the wounds show infection. In general surgery expectancy of wound infection is between 4 and 6 per cent. Eliason reports that hemolytic streptococcus and Streptococcus viridans represent 47 per cent of all infections, and are concerned in 95 per cent of the mortalities in amputations for gangrene. He also reports that before insulin, at the University of Pennsylvania, the average diabetic death was at the age of thirty-seven years. At present it is at fifty-one years of age.

SUMMARY

1. Wound healing is impaired in the presence of a marked amount of sugar.

2. I prefer a small amount of sugar in the urine in what we might call the "chronic" diabetic who has been operated upon.

3. Preoperative care and preparation increases the recovery percentage.

4. Careful selection of the anesthetic is essential.

5. The preoperative and postoperative cooperation of the medical attendant reduces the surgical risk in the diabetic.

6. The proper use of insulin, with glucose is responsible for a marked decrease in the mortality.

7. Finally, diabetes is no contraindication to surgery.

[For References see p. 353.]

FORENSIC MEDICINE

EDITOR: HARRISON S. MARTLAND, M.D.

EVOLUTION AND PRESENT STATUS OF

DIFFERENTIAL PRESSURES IN RESUSCITATION AND THORACIC SURGERY*

POL. N. CORYLLOS, M.D.

NEW YORK CITY

PATHOLOGIC PHYSIOLOGY OF ASPHYXIAL DEATH

PULMONARY ventilation is a complex function which is accomplished by the rhythmic expansion of the chest, which produces a rhythmic increase and decrease of the capacity of the thoracic cavity. The lungs represent two elastic balloons which under normal conditions are distended and forced to fill the chest cavity because of the negative intrapleural pressure, which in its turn is due to and measures the elastic recoil of the lungs.

During expiration the chest walls collapse, the diaphragm rises, and the capacity of the chest diminishes; naturally the lungs obeying their elasticity partially collapse, and the intrapulmonary pressure increases, and a part of the air contained in them is expelled while the intrapleural pressure becomes less negative. Expiration is thus a passive phase of the respiratory cycle, the only active part in which is represented by the actual contraction of the bronchioli, as Luisada has recently shown.

Inspiration on the contrary is an active phenomenon due to the combined action of the inspiratory muscles, which produce elevation and abduction of the ribs and the sternum and lowering of the diaphragm. The capacity of the thoracic cavity is increased, the lungs are forced to expand, the intrapulmonary pressure decreases, and air rushes into them, while the intrapleural pressure becomes more negative. Respiration is thus carried on by the rhythmic production of differential pressure between the pulmonary and the outside air.

It is obvious that respiration, or more exactly pulmonary ventilation, cannot be accomplished in a normal way unless all the factors entering in its production remain normal. These factors are: the normal functioning of the respiratory center, the integrity of the respiratory muscles and the motor nerves of these muscles (and to some extent, the normalcy of vagosympathetic afferent and efferent fibers), the patency of the respiratory ways, and the maintenance of the negative value of the intrapleural pressure. Paralysis of the respiratory center, paralysis of the respiratory muscles or suppression of the intrapleural pressure will necessarily produce failure of the respiratory function.

The respiratory center is stimulated and regulated by the nervous stimuli conveyed to it through all sensory nerves of the body, and more particularly through the vagi; more especially however it is regulated by the hydrogen ion concentra-

* Read before the Society for the Prevention of Asphyxial Death.

tion of the blood, represented almost exclusively by the ratio $\frac{H_2CO_3}{NaHCO_3}$ and in last analysis by its CO_2 content. Conversely the respiratory center regulates the content of CO_3 in the blood, which in that way is maintained absolutely constant. Even the slightest variations of the CO_2 content in the blood will produce marked variations in the respiratory rhythm; increase of CO_2 causes deeper respiration and hyperpnea, without marked influence upon the respiratory rate; decrease of CO_2 produces slowing of the respiration and at the end apnea. On the other hand, the nervous cells of the respiratory center require a considerable amount of oxygen to satisfy their metabolic needs. Decrease of the oxygen content of the arterial blood is accompanied by tachypnea which starts a vicious circle: elimination of CO_2, periodic breathing, apnea, and increased anoxemia, leading to fatigue and paralysis of the respiratory center; increase of oxygen above the normal limts, on the contrary, is accompanied by no marked changes as long as the CO_2 content remains normal and the partial tension of O_2 remains below 600 mm. Hg (80 per cent).

The regulation of O_2 and CO_2 content of the blood, however, depends in the last analysis upon the condition of the alveolar epithelium, through which gas exchanges occur between the alveolar air and the venous blood circulating in the alveolar capillaries. This epithelium represents a surface of about 1000 square feet; through it 300 c.c. of oxygen pass from the alveolar air into the blood and about as many of CO_2 pass from the blood into the alveolar air in one hour per kilogram body weight. In other words, 300 c.c. of O_2 pass into the blood in one minute in the lungs of a man of 60 kg. (150 pounds) at rest, or 20 liters in one hour and 480 liters in twenty-four hours. In exertion this amount may become ten times greater. This gives a fair idea of the tremendous activity of gas exchanges in the lung, which seems to be accomplished under normal conditions without the slightest effort. On the other hand, although we need such colossal amounts of oxygen for maintenance of life we have no other reserves of it in our organisms outside of the 4000 c.c. of air contained in our lungs; the content of oxygen of the alveolar air being 15 per cent, the whole reserve of oxygen in it is 600 c.c., that is the necessary amount for about two minutes.

The foregoing considerations make it obvious that any serious disturbance of any one of the links of the respiratory chain will lead to anoxemia with or without retention of CO_2 or acapnia, and gradually or rapidly, according to the degree of anoxemia will lead to death by asphyxia.

It is necessary to point out here that what we generally designate as asphyxia, that is, gasping for air accompanied by intense cyanosis, represents only one form of asphyxia, which in fact is the less dangerous form. In that form there is retention of CO_2 which stimulates the respiratory center, deepens the respiratory movements and allows the lungs to get some oxygen as this occurs in obstructions of the respiratory ways or in marked reduction of the available pulmonary tissue. In fact, we should not forget that, at rest, we use hardly one-twentieth of our alveolar surface.

Much more serious is the other form of asphyxia in which there is no cyanosis. This form is due to anoxemia without retention of CO_2 as in lesions of the respiratory membrane (war gases), or decrease of the respiratory field as in inflammatory processes or edema of the lung, or in marked decrease of hemoglobin following hemorrhage. Shallow rapid breathing in this form is present, causing anoxemia and excessive elimination of the easily diffusible CO_2, leading as already stated to fatigue and definite disorganization of the respiratory center. In this form of asphyxia, designated often as gray asphyxia, there

is neither gasping for air nor any marked subjective or objective signs of distress; death occurs without any of the alarming symptoms of blue asphyxia.

This rapid and necessarily incomplete resume of a few points of the physiology of respiration shows the multiplicity and complexity of causes and clinical forms of anoxemic deaths.

It is obvious that as long as the respiratory center is active, the respiratory muscles functioning, the respiratory ways patent and the intrapleural pressure intact, as for instance in CO poisoning of moderate severity, or in partial disablement of the lung parenchyma as in inflammatory processes of the lung, edema, or drowning of slight duration, inhalations of oxygen, CO_2 will suffice to restore respiratory function.

It is not the same when prolonged anoxemia in the afore-mentioned conditions has produced fatigue of the respiratory center and arrest of respiration or when paralysis of the respiratory muscles or suppression of the negative intrapleural pressure or obstruction of the respiratory ways has rendered impossible spontaneous pulmonary ventilation. In these cases we must force the air into the lungs, after having assured of course the patency of the respiratory ways. This can be accomplished either by creating negative pressure in the chest so that air will be obliged to rush into the lungs, or by introducing air into the lungs under positive pressure. In both cases we create differential pressures and we endeavor to maintain pulmonary ventilation by artificial means until spontaneous respiratory movements are restored.

Although in all these conditions the real cause of death is the same, that is, anoxemia, the treatment must vary according to the cause which has produced anoxemia. Therefore, the indications of differential pressure should be discussed separately for each one of these forms of anoxemia.

INDICATIONS OF TREATMENT ACCORDING TO THE CAUSE OF ASPHYXIA

1. *Suppression of Negative Intrapleural Pressure.* Intrapleural negative pressure is due to the constant absorption of any gases which might be present in the pleural cavity, by the blood circulating in the pulmonary capillaries. In fact, after death and arrest of circulation a certain degree of pneumothorax is always developed. Communication of the pleural cavity with the outside air, either through an opening in the chest wall or through an opening in the lung, will allow air to enter into the pleura and thus create pneumothorax. If the openings of the chest wall or of the lung are small and of short duration the collapse of the corresponding lung will be only moderate and temporary; the respiratory disturbances will be moderate and of no importance. On the contrary, when the openings are very wide, as in extensive wounds of the chest or in large surgical thoracotomies, not only will the corresponding lung be completely collapsed and incapacitated but according to the major or minor degree of mobility of the mediastinum, ventilation of the other lung will be more or less impaired. Roughly, in less than 50 per cent of cases large openings of the chest can be made without any dangerous impairment of both respiration and circulation. The danger is naturally must greater when both pleural cavities are opened, as this might occur in intrathoracic operations for tumors of the lung, mediastinum, or esophagus, by accidental opening of the mediastinal pleura.

These dangers and complications following surgical pneumothorax have been the principal causes of the long delay in the development of thoracic surgery. The chest has been the "no man's land" for the surgeon until twenty-five years ago. It can be said that the development of thoracic surgery started with the use of differential pressure as introduced by Sauerbruch, Brauer, Engelken, and others.

In these methods either the body of the patient was placed in a cabinet in which negative pressure was maintained, whereas the head was under normal pressure outside of the cabinet, or the opposite conditions were created, that is, the head was placed in a cabinet under positive pressure whereas the body was outside and under normal atmospheric pressure. It is obvious that in either method, negative or positive differential pressure, the collapse of the lung is prevented, although the pleural cavity is widely opened.

The same effect can be obtained by intratracheal insufflation of air or oxygen, or even more simply by applying an air-tight anesthetic mask upon the face of the patient and raising the pressure into the mask, as in the apparatus of Tiegel.

2. *Impairment of the Patency of the Respiratory Ways or of the Respiratory Membrane.* The patency of the respiratory ways may be impaired by a great number of pathologic conditions. Among these conditions foreign bodies, organic lesions, tumors, false membranes as in diphtheria, inflammatory lesions, and bronchial obstructions as in pneumonia, tuberculosis, etc., edema of the glottis, to mention only a few, are the most frequent causes producing respiratory disturbances and anoxemia. The smaller bronchi and the alveolar epithelium may be incapacitated by inflammatory lesions as in bronchopneumonia and acute bronchio-alveolitis, edema as in circulatory decompensations, by aspiration of irritating or caustic gases, or by drowning of the lung as by profuse bronchial or pleural exudates or in submersion.

It is evident that in these cases the first indication is rapid reestablishment of the patency of the respiratory ways, either by the removal of the obstructing agents or by creation of a new opening in high obstructions by tracheotomy. The problem is more complex when the small bronchi and the alveolar membrane are functionally impaired.

In the first case, after reestablishment of the patency of the glottis and large bronchi, inhalation of O_2 and CO_2 may be sufficient, or intratracheal insufflation may become necessary according to the condition of the respiratory center.

In edema or in drowning of the lung, of whatever origin, simple inhalation is sufficient only in a limited number of cases. In fact, in a number of cases oxygen under high partial pressure should be brought in intimate contact with the still functioning portions of the respiratory membrane. This cannot be realized by ordinary inhalation by which it is impossible to raise the partial pressure of the alveolar air above 40 to 45 per cent. We need in these cases 60, 70, 80 and 90 per cent of oxygen in order to make up the often extreme limitation of the respiratory field, and to increase accordingly the amount of O_2 dissolved in the fluid filling up the alveoli; this oxygen can be taken up by the alveolar blood and thus allow a sufficient degree of oxygenation. Haldane has shown that mice can live in a mixture of equal parts of CO, and O_2, provided that the pressure of oxygen is raised to 2 atmospheres. Under these conditions 4.2 per cent of oxygen enters in solution in the plasma which is as much as the lungs take up from the blood. In the experimental work on submersion carried on in animals and on the human with Drs. Flagg and Birnbaum we were able to maintain life in dogs, the lungs of which were filled up with water, by insuffiating into the lungs by means of an endotracheal catheter pure oxygen under positive pressure. Hoover has distinguished extrinsic and intrinsic edema. In the first, in which the alveoli are filled with exudate but the alveolar membrane is healthy and permeable to gases, anoxemia was rapidly corrected by oxygen inhalations. In the second where the alveolar membrane is infiltrated and thickened so that gas exchanges are impaired, simple O_2 inhalations could not correct anoxemia. In these cases endotracheal oxygen insufflation by expelling and taking the place of nitrogen raises the partial pressures of

O_2 in the alveolar air. Furthermore, it distends the alveoli, and thus increases the respiratory field and, in addition, it puts in action the Hering-Brauer reflex.

A similar condition is present in asphyxia of the newborn. When it is due to persistent atelectasis of the lung caused by obstruction of large or smaller bronchi, by mucous plugs, or often by amniotic fluid as in premature respiration, intratracheal insufflation as proposed by Flagg distends the lung, introduces air into the alveoli beyond the agent of obstruction and besides it stimulates the respiratory center through the Hering-Brauer reflex. Similar complications may occur in thoracoplastic operations upon tuberculous patients, or in operations for bronchiectasis. During the operation the exudate filling the diseased lung passes by gravity into the healthy bronchi and may cause serious anoxemia during the operation. These bronchial obstructions due to internal drainage, well studied by Faulkner, Brunn and his co-workers, may become the origin of serious hemorespiratory complications during the hours and first days following operation, because of the inability of these patients to cough and expectorate. For these reasons in all my tuberculous patients submitted to thoracoplasty, who expectorate more than 15 to 20 c.c. in twenty-four hours, I use my special intratracheal catheter. Four hundred thoracoplastic operations have been carried out so far by this method, with practical elimination of postoperative bronchopulmonary complications, and a striking decrease of postoperative morbidity and mortality.

3. *Paralysis of the Respiratory Muscles.* Pulmonary ventilation is not seriously impaired unless all intercostal muscles and the diaphragm are paralyzed at the same time. If only the first or only the second are paralyzed respiration can still be carried on by the others. This condition is occasionally realized in infantile paralysis, more rarely in cerebral and especially bulbar, pathologic or traumatic lesions. In these cases asphyxia occurs because of partial or complete suppression of the mechanical factor of pulmonary ventilation. It is obvious that simple differential pressure cabinets as used in thoracic operations with wide opening of the chest and surgical pneumothorax are not sufficient in these cases. The methods which can and should be used in these conditions are intratracheal insufflation or artificially induced rhythmic expansion and retraction of the lungs.

Intratracheal insufflation by means of an intratracheal catheter reaching the bifurcation of the trachea was used long ago by Meltzer and Auer, Elsberg, and others. Curarized dogs can survive over twenty-four hours by this procedure. However, excessive elimination of CO_2 and possible traumatism of the trachea by prolonged use of this method renders it improper in cases with paralysis of the motor respiratory system of long duration.

Artificial respiration can be performed either by instituting direct rhythmic expansion and collapse of the lungs, as it can be obtained by active variations of the intrapulmonary pressure, or by providing indirect expansion and collapse of the lungs by means of rhythmic compression and dilation of the chest. Direct active expansion and retraction of the lungs can be realized by rhythmically interrupted intratracheal insufflation, or by the apparatuses designed as pulmotors. Lately I had the opportunity to experiment on animals with an apparatus known as E and J Resuscitator and Inhalator, which presents a number of excellent points. Further investigation however is necessary in order to establish the scientific value of this ingenious apparatus.

Indirect expansion and retraction of the lungs by rhythmic movements of the chest walls can be obtained either by the usual methods of manual artificial respiration, among which the method of Schaefer is to be preferred, or by the production of oscillating negative pressure in a box in which the body of the patient is enclosed air-tightly, while his

head is kept outside of it. Upon this principle is based the apparatus of Drinker. It is perhaps of interest to recall that this principle was first used by Birnbaum and myself in 1926 in our experimental work upon atelectasis and on absorption of different gases in the lung. Dogs with the chest wide open were placed in a box closed air-tightly, the head of the animal being kept outside of it. An oscillating negative pressure by means of a mechanically actioned valve was created in the box, the manometric values of which were equal to the manometric oscillations of the intrapleural pressure of the animal taken before the opening of the chest.

The merit of this type of apparatus is that its action can be maintained for a long time without injury to the lung. It must be said, however, that its use must be combined with oxygen, CO_2 inhalations, and the maintenance of the patency of the respiratory ways. Lately the life of two of my patients, who had presented extensive tuberculous bronchopneumonia, following thoracoplasty, was saved by prolonged use (three and seven days) of the respirator of Drinker.

PARALYSIS OF THE RESPIRATORY CENTER

This dangerous complication may develop either suddenly or progressively. The type of the first is the apnea occurring suddenly during anesthesia. The second is the gradual slowing down and arresting of respiration due to the influence of narcotics as morphine, opium, alcohol, barbyturic derivatives in high doses, and so forth.

In apnea occurring suddenly during anesthesia, differential pressure should be instituted immediately in order to maintain pulmonary ventilation until the acute anoxemia is suppressed or the excess of anesthetic is eliminated and the center has recovered its normal function. We should never forget that the time of successful resuscitation in these cases is limited to seconds. Loss of only one minute may prove fatal. When the respiratory ways are patent I know of no better method in these cases than mouth to mouth insufflation. It can be applied immediately. No more than the right amount of air can be insufflated each time. The insufflated air has the right temperature and the right O_2 and CO_2 content and it is insufflated in the right intervals, regulated by the respirations of the insufflating person. It is the ideal differential pressure method for resuscitation. I owe to this method a number of really spectacular resuscitations in the operating room. Of course this procedure cannot be prolonged for a long time. But at any rate it gives time to proceed with intubation of the patient by which both inspiration and insufflation can be continued. The method of Flagg already mentioned has given brilliant results in these cases. Artificial respiration by manual manipulation can be combined with direct insufflation in these cases, but I earnestly believe that it should never replace it. Our principal preoccupation in these cases should be to maintain by all means the oxygenation of the respiratory center. The nervous cells of this center cannot resist a deep anoxemia over fifteen to thirty seconds without undergoing definite changes. As long as the heart beats life can be restored. I have seen resuscitation occur in patients and in submersed humans and animals in whom there were no audible heart beats, although they were still present as shown by the movements communicated to the needle used for intracardiac injections of adrenalin. I have the impression that in these cases the E and J Resuscitator Inhalator may be of help because of the facility with which it can be switched from rhythmic insufflation and suction to simple inhalation, and vice versa.

In asphyxia by CO poisoning or in submersion, differential pressure should be prolonged even after the immediate danger is over. In these cases it should be combined with O_2 and CO_2 inhalations in order to avoid pulmonary complications

frequently following them. Henderson and Haggard have clearly shown this point.

CONCLUSIONS

In closing this study I shall submit the following conclusions:

1. Pulmonary ventilation under the normal condition is assured by the rhythmic expansion and retraction of the chest which creates rhythmically oscillating differences of pressures between the intrapulmonary and the outside air.

2. Pathological conditions impair this mechanism. Oxygenation and life can be maintained only by artificially supplying the suppressed differential pressures.

3. The procedures to be used in each case are dictated by the causes of the respiratory disturbances. Therefore an accurate diagnosis of the cause of asphyxia should be made in each individual case.

4. Anoxemia and acapnia are the two causes of asphyxial death. The importance of CO_2 should not be underestimated. No rational treatment of anoxemia can be carried on without an exact knowledge of the significance of CO_2 in respiration.

5. In the diagnosis of asphyxia the presence of cyanosis is not compulsory. On the contrary, the most dangerous forms of anoxemia are accompanied by excessive elimination of CO_2 and consequently by absence of cyanosis. In these cases death occurs without any conspicuous subjective or objective symptoms.

6. Simple apparatuses and simple methods have replaced cumbersome machines used in the past, especially in relation to thoracic surgery. In that special surgical field the anesthetist is one of the most important members of the surgical group.

7. It is my conviction that gas therapy treatment of respiratory disturbances must be carried out by especially trained men having a thorough knowledge of the physiology and pathologic physiology of respiration. It is hoped that this work will be carried on in the future by the anesthetist who more than anyone else is prepared for this task.

CONCLUSION OF DR. JEWETT'S ARTICLE*

splints, with or without the use of a posterior splint. Twenty-five, or 23 per cent, were put up in lateral moulded splints (Reconstruction Hospital splints) with or without the use of a posterior splint. Four of these, or 3.6 per cent, had only a posterior splint applied. In 51, or 46 per cent, circular plaster casts were applied; these cases include all of those which were put up in walking casts at the time of original treatment. The cases in which we anticipated swelling were put in splints and the patients hospitalized for a few days. Thirteen, or 12.4 per cent, had skeletal traction by means of Kirschner wire through the os calcis or had open operation and immobilization in a cast.

SUMMARY

The U or sugar-tong moulded plaster splint has a wide range of usefulness in injuries to both upper and lower extremities. Advantages over plaster casts are lightness, ease of removal for inspection and dressings and the avoidance of too tight immobilization.

REFERENCES

Tracy, E. A. An apparatus designed for the treatment of dislocation (upward) of the acromial end of the clavicle. *Boston M. & S. J.*, 128: 186–188 (Feb. 23) 1893.

Ware, M. W. Plaster of Paris, and how to use it. Am. J. Surg., 20: 111–112 (April) 1906.

Eliason, E. L., and Ebeling, W. W. Treatment of fractures of the tibia. *Surg., Gynec. Obst.*, 57: 658–667 (Nov.) 1933.

* Continued from p. 339.

IS ALCOHOL A SURGICAL PROBLEM?

HERMAN A. HEISE, M.D.

MILWAUKEE, WIS.

IN 1933, there were reported in Pennsylvania 49,834 persons who were injured or killed in automobile accidents. A two year survey conducted in Fayette County of automobile accidents involving injury or death, revealed that alcohol was involved in about 60 per cent of the accidents and that 75 per cent of the people injured or killed were in "alcohol accidents." These figures were obtained by chemical analyses of body fluids; and it should be borne in mind that the individuals in the "alcohol accidents" were not necessarily obviously intoxicated, but were recruited chiefly from the ranks of the "moderate drinkers." They were drivers or pedestrians who by ingestion of alcohol had dulled the most highly developed portion of the brain.

Experiments under actual driving conditions illustrate the mental attitude of the drivers who have had a few drinks. Although ordinary tests would not have classified them as "drunk," they made remarks giving an insight into their conditions, such as: "I feel foggy"; "I say things before I think them"; "Things don't convey the same meaning"; "Test is getting hard"; "Feel good, don't give a damn about anything." Although ordinary driving was well done, they all responded poorly to unusual driving conditions and were largely unaware of their shortcomings.

An important finding which should be understood by every driver, and which helps explain many of the child pedestrian accidents, is the fact that it takes the sober driver about 0.4 seconds from the time that an impulse to stop is received until he can take his foot off the throttle and begin to apply the brake. If he is traveling 30 miles an hour, which is 44 feet per second, it means that his car is running without brakes for about 18 feet; and then it will travel about 40 feet more before it can be stopped. What chance would there be to avoid hitting a child who suddenly appeared in a narrow lane 50 feet away when the driver was traveling 30 miles an hour? Alcohol definitely increases the reaction time by as much as 0.1 to 0.2 seconds, thus increasing by many feet the distance the car runs without brakes.

All the injured persons in the survey required some hospital treatment. In most cases, an intern was able to administer the required treatment, and long hospitalization was unnecessary; but many persons required long and expensive hospital treatment. Naturally, the care of accident cases falls upon the surgical staff, and all too frequently the surgeon's only reward is the satisfaction of restoring the injured to health. When the bill is presented, a common reply is "I'll pay you when the fellow who bumped me pays me." Economic conditions will always provide an abundance of real charity cases for all surgeons; but it is unfair to expect them to bear the burden of human carelessness, especially when augmented by alcohol. The solution of the problem appears to be one of education. The driver should realize the responsibility of keeping his head clear and the necessity of carrying insurance so that the victims of his unavoidable accidents may be given proper care. Incidentally, it is unfair for the "dry" driver to pay the same premium demanded of the man who is responsible for most of the accidents. Since some individuals will insist on drinking and driving, careful examinations of all persons involved in accidents should include a

chemical test for alcohol in body fluids. This is important to the civil authorities and also to the surgeon who is frequently called upon to determine what part alcohol plays in the symptoms of the patient. The commonest example is that of the man who has been drinking and may have a fractured skull. Here a routine examination of the spinal fluid, including examination for alcohol, frequently determines what should be done for the patient. The surgeon may be called into court to describe the injuries and also to express an opinion as to the state of sobriety or intoxication of the patient; and without a chemical test to corroborate his findings, he is at the mercy of unscrupulous attorneys and stupid juries. It is important to know that the amount of alcohol found in blood or urine is a means of determining the minimum amount of alcohol consumed and also parallels the state of intoxication of a person.

The method of performing the chemical test for alcohol in body fluids, as well as its medicolegal value, is discussed in previous publications.

SUMMARY

1. Education of the public regarding the role of alcohol in automobile accidents may decrease the number of accidents.

2. Hospitals and surgeons should be assured of their fees by insurance of drivers of motor vehicles.

3. The chemical test for alcohol should be used to evaluate the role of alcohol, particularly in suspected fracture of the skull.

4. The surgeon is often unable to substantiate his opinion of drunkenness without a chemical test for alcohol.

REFERENCES

1. Heise, H. A., and Halporn, B. Medicolegal aspects of drunkenness. *Pennsylvania M. J.*, 36: 190–195, 1932.
2. Heise, H. A. The specificity of the test for alcohol in body fluids. *Am. J. Clin. Path.*, 4: no. 2 (March) 1934.
3. Heise, H. A. Alcohol and automobile accidents. *J. A. M. A.*, in press.

REFERENCES OF DRS. ERDMANN, CLARK AND BUCKLEY*

1. Maes, U. Surgery of diabetes. *Surg. Gynec. Obst.*, 51: No. 5 (Nov.) 1930.
2. Eliason, E. L. Surgery of diabetic gangrene. *Ann. Surg.*, 98: No. 1 (July) 1933.
3. McKittrick and Root. Diabetic Surgery. Phila., Lea & Febiger, 1928.
4. Witherspoon, J. T. Simplified postoperative routine for the diabetic. Am. J. Surg., n.s. 17: 418, 1932.
5. Allan, F. N. Surgery and diabetes. *Surg. Clin. N. Amer.* (Lahey Clinic), p. 789 (June) 1933.
6. Hauser, E. T., and Foster, N. B. Surgical aspects of diabetes. Nelson's Loose Leaf Living Surgery, 2: 263.
7. Ohler, W. R. Care of the surgical diabetics. *New England J. M.*, 201: 259 (Aug. 8) 1929.
8. Joslin, E. P. Treatment of Diabetes Mellitus. Phila., Lea & Febiger, 1923, p. 611.
9. Allen, F. M. Management of surgical diabetic cases. *Long Island M. J.*, 23: 587 (Oct.) 1929.
10. Saunders, E. W. Diabetes in relation to surgery. *Ann. Surg.*, 94: 161 (Aug.) 1931.
11. Joslin, E. C. *Indiana M. A. J.*, 97: 595 (Aug.) 1931.
12. Thurston, A. J. Surgery in diabetes. *Indiana M. A. J.*, p. 319, (July) 1933.
13. Judd, E. S., Wilder, R. M., and Adams, S. F. *J. A. M. A.*, 86: 1107, 1926.

* Continued from p. 344.

NEGATIVE PRESSURE CABINET (RESPIRATOR) TREATMENT OF ASPHYXIA*

DOUGLAS P. MURPHY, M.D.

PHILADELPHIA

ARTIFICIAL respiration carried on by varying the air pressure upon the surface of the body was described first by Doe in 1889,[1] but received no further mention in the literature.

Devised for the treatment of asphyxia of the newborn, his apparatus consisted of a box, or negative pressure cabinet, covered at one end with a piece of sheet rubber. The infant was placed in the box with its nose and mouth applied to a small opening in the rubber. The air pressure upon the body surface was varied by blowing and sucking through a rubber tube connected with the box.

Mechanically induced changes of pressure were employed clinically first by Drinker and Shaw[2] in 1929.

Their apparatus differs in principle from that of Doe in that the head of the patient protrudes from the box through a snugly fitting rubber collar, and the variations in air pressure are produced by an electrically driven pump and valve arrangement. Many machines, constructed on the Drinker model, are now in operation in this country, and are being employed in the treatment of both adults and infants.

The choice of a method for artificial respiration depends largely upon circumstances. By reason of its size and weight, the mechanically operated negative pressure cabinet is limited either to the treatment of patients who are stricken with respiratory weakness or paralysis in institutions possessing such a machine, or to patients who can reach a machine before death occurs. The respirator also should be limited to the treatment of individuals whose upper air passages are clear, whether they be adult or infant.

Among other uses, the negative pressure cabinet has been employed successfully in the treatment of adults suffering from (a) respiratory weakness due to infantile paralysis, (b) carbon monoxide gas poisoning, (c) alcoholic coma, (d) drug poisoning, and (e) postoperative respiratory failure. It has been used with success also in the treatment of both the *immediate* asphyxia of the newborn, and the respiratory arrests which newborn infants may exhibit, for the first time, a day or two after birth.

The respirator, as an instrument for initiating and maintaining artificial respiration, operates primarily by producing a subatmospheric pressure upon the thoracic walls. When this occurs, the lungs are inflated by the force of the normal, or atmospheric pressure, acting through the subject's nose and mouth which are outside of the negative pressure cabinet. Release of the negative pressure in the cabinet, with a return here, to atmospheric pressure, permits the expanded respiratory muscles to contract, and thereby to expel the air forced into the chest by the atmospheric pressure outside of the cabinet. Repetition of these changes produces respiratory movements.

There is evidence to indicate that the efficiency of negative pressure alternating with atmospheric pressure is increased by replacing the atmospheric pressure with positive (supra-atmospheric) pressure, at

[1] Doe, O. W. Apparatus for resuscitating asphyxiated children. *Boston M. & S. J.*, 120: 9, 1889.

[2] Drinker, P., and Shaw, L. A. An apparatus for the prolonged administration of artificial respiration. *J. Clin. Invest.*, 1: 229–247, 1929.

* From the Gynecean Hospital Institute of Gynecologic Research, School of Medicine, University of Pennsylvania.

least in the treatment of certain pathological conditions. This combination of pressures, however, requires further study. Clinical observations indicate that the use of positive pressure is quite unnecessary, in the treatment of patients possessing a certain amount of muscle tone, and it is uncomfortable to conscious subjects.

If positive pressure is to be used, between the periods of negative pressure, it is important that the *degree* of the positive pressure does not exceed that of the negative pressure. Otherwise, the blood volume in the lungs is reduced with each application of positive pressure, and thereby adequate oxygenation is interfered with. The disadvantage of using excessive degrees of positive pressure has been strikingly shown in experiments by the speaker, upon experimentally paralyzed cats. In these animals, a marked cyanosis resulted.

The mode of operation of a respirator (using negative pressure alternating with atmospheric pressure) depends upon whether an adult or an infant is being treated, and upon the degree of respiratory difficulty.

For individuals of both ages, and regardless of the extent of the respiratory weakness before treatment is begun, the upper air passages should be cleared. It is unnecessary to say that artificial respiration should be started at the earliest possible moment, and should be continued either until spontaneous breathing develops, or death occurs.

To ascertain that death has occurred, it may be necessary to open the cabinet, which interrupts the treatment, and auscult the heart. The difficulty encountered in getting at the body, without interrupting treatment, is a disadvantage of this method of artificial respiration. If the heart continues to beat, though spontaneous breathing does not take place, treatment naturally should be continued indefinitely.

The treatment of patients in a respirator makes it possible to observe the characteristics of the onset of spontaneous breathing. The asphyxiated newborn infant, with which the writer is more familiar than with asphyxiated adults, may exhibit a long period of apnea while receiving artificial respiration. This, however, in many cases, appears to be greatly shortened by the artificially induced respiratory movements. The first spontaneous respiratory act is usually a gasp. This may be followed by more gasps, and these may increase in both vigor and frequency.

Since little appears to be known regarding the efficiency of these gasping movements, with respect to their power in bringing about an adequate oxygenation of the blood, it seems wise to continue the respirator treatment throughout this period of gasping until a normally active rate and amplitude of spontaneous movements is established.

Certain asphyxiated individuals, though their cardiac action continues, fail to develop spontaneous respiration in the negative pressure cabinet. Others, possessing a small amount of respiratory power, become progressively worse. In such cases, the inexperienced attendant frequently feels called upon to greatly increase the degree of negative pressure. That any great increase in this pressure is unwise, is borne out by: (a) observations upon the comfort of conscious, convalescent patients, (b) study of the lungs of patients who have died while being respirated, and (c) by the condition of the lungs of experimental animals. Space does not permit a discussion of these observations, but it can be said, in passing, that the use of high degrees of negative pressures in the treatment of such patients may seriously injure their pulmonary tissues. It is important, therefore, that the use of so powerful an instrument as a respirator be operated only by an individual familiar with its potential dangers.

The negative pressure cabinet appears to have beneficial physiological effects in addition to that of maintaining artificial respiration. In unpublished experiments,

the speaker and William Duane have measured both cerebrospinal fluid pressure and intracranial venous pressure in dogs receiving artificial respiration in a negative pressure cabinet. The treatment reduced both of these pressures. So, if asphyxia is caused, or is aggravated by an unusual increase in intracranial pressure due to cerebral congestion on intracranial hemorrhage, the use of a respirator should tend to relieve the cerebral congestion and thereby reduce the intracranial pressure. In these same experiments, it was observed that the pressure of the rubber collar upon the dog's neck increased the venous and spinal fluid pressures above normal, if the motor was not operating. This observation points to the necessity for always keeping the collar loose until the cabinet is closed and the motor is started.

That the respirator is not without benefit to the cardiovascular system also is suggested by an observation recently made by the writer.[1]

An adult patient suffering from heart disease, who experienced a severe degree of shortness of breath whenever in the recumbent posture, and continuous palpitation of the heart when in any posture, was given artificial respiration in a respirator for a period of several hours. Simultaneously with the start of treatment, and with the subject in the recumbent posture, the shortness of breath disappeared. The patient was perfectly comfortable flat on his back. After twenty minutes of artificial respiration, the palpitation of the heart disappeared, and this remained in abeyance throughout the treatment, and for several hours thereafter.

The success of the treatment probably depended on a number of factors: (1) The patient was relieved of the work necessary to carry on respiration. (2) The chest was expended mechanically to a greater degree than spontaneously, and sufficiently to maintain a satisfactory pulmonary aeration. Also, the negative pressure created in the chest probably aided the return flow of blood to the heart.

These observations point to the possible value of the respirator as an emergency measure for the treatment of patients with acute cardiac failure. By placing such patients in a respirator, it might be possible to give them immediate cardiac assistance during their most critical period and before it becomes possible to digitalize or otherwise treat them.

In addition to these effects upon (a) pulmonary ventilation, (b) intracranial pressure, and (c) blood flow, the respirator appears to have other advantages: The patient's body can be kept in a temperature which will prevent excessive loss of body heat, while at the same time, he can breathe the cooler air outside of the machine, which possesses a more satisfactory degree of moisture than the air inside of the cabinet. This feature is especially advantageous in the treatment of premature infants.

If, after spontaneous respiration is once established, it weakens, or if the heart action weakens, by the simple manuever of throwing an electric switch, the machine will again immediately assume part of the load previously carried by the body. This latter feature is also especially valuable in caring for those premature infants who exhibit a very unstable respiratory mechanism.

In conclusion, it may be stated that there seems to be no contraindication to the use of the negative pressure cabinet in the treatment of any adult or infant suffering from respiratory embarrassment, except in the case of individuals whose upper air passages are obstructed. It appears to be one of the most scientific methods for inducing and maintaining artificial respiration, in that in its use, the subject is exposed to no force which cannot be both controlled and measured. It is perhaps the best means available for carrying on *prolonged* artificial respiration.

[1] Wolfe, E. F., and Murphy, D. P. Relief of cardiac dyspnea by Drinker respirator. *J.A.M.A.*, 101: 598, 1933.

CASE REPORTS

PRIMARY LEIOMYOSARCOMA OF THE APPENDIX

WITH A REVIEW OF THE LITERATURE*

HERMAN CHARACHE, M.D.

BROOKLYN, N. Y.

PRIMARY leiomyosarcoma of the appendix has not previously been reported in the literature. Evidently this type lesion is extremely rare, for of the 22 cases of sarcoma of the appendix reported, none was of this type. In many instances carcinoma and carcinoid types of tumors of the appendix are confused with sarcoma because they occur more often.

In our service at the Brooklyn Cancer Institute, out of approximately 10,000 cases treated during the past ten years, only this one case of leiomyosarcoma has been found.

A list of the 22 cases already reported is appended hereto in tabulated form, outlining the clinical, surgical and pathological findings in each case.

In all the cases reported, including this one, recognition of the pathological condition present was possible only after operation and examination of the removed tissue. Most cases exhibited the usual symptoms of appendicitis or other indefinite abdominal distress. There was no specific symptom leading to the diagnosis of sarcoma. The case herein described is reported because of its rarity and the type of histological findings.

CASE 1. A. S., white, adult male, aged sixty-six, acutely ill, was admitted to Cumberland Hospital on March 3, 1933. On December 30, 1932 the patient had entered another hospital complaining of pain in the right lower quadrant of two and one-half weeks' duration. Examination at that time revealed a visible and palpable mass in the right lower quadrant. This mass was firm, fixed, and painful on palpation. A clinical diagnosis of acute appendicitis was made, and on December 31, 1932 the usual operation for such a condition was attempted. However, when the peritoneum was opened, free sanguinous fluid was found in the peritoneal cavity. This fluid contained some papillary material. The tip of the appendix was attached to the cecal wall. On manipulation the tip of the appendix and cecal wall came away en masse, leaving a fistulous opening into the cecum. The operation was completed with drains in place.

Examination of the removed appendix and adherent tissues by Dr. Max Lederer was reported as follows:

"Appendix 8 cm. long. The proximal end is free; the distal end is attached to a section of gray tissue about 2 mm. in thickness, the outer coat of which is peritoneal lining which appears to reflect from the appendicial serous coat with which it is continuous. The inner lining of this tissue appears to be intestinal mucosa. Longitudinal section through the appendix fails to show any communication between the lumen of the appendix and the apparent mucosa of this section of tissue, which is presumably cecal wall. The wall of the appendix is slightly thickened. Its surface is gray and smooth, its contents are blood and mucus, and its lining is gray and rough. There is no neoplastic change noted on the gross in the lining of the organ.

"Accompanying the specimen, however, are found a number of soft gray masses, some of which contain hemorrhagic areas. This tissue

* From the Brooklyn Cancer Institute, Dr. Ira I. Kaplan, Director.

TABLE I

REVIEW OF CASES OF LEIOMYOSARCOMA OF THE APPENDIX

	Sex	*Age*	*Symptoms*	*Physical Findings*	*Operative Findings*	*Operative Procedure*	*Patbological Report*	*Result*
Gilford Hastings. *Lancet*, 2: 241, 1893	F	27	Chronic appendicitis for 13 years aggravated during pregnancy	Growth in what was thought right kidney region, diagnosed as sarcoma of the kidney	Hard, fixed nodular mass apparently originating in kidney, but was found to originate about cecum and appendix. Latter contained fecal concretion	Part of ileum, cecum and appendix removed through lumbar incision	Spindle-cell sarcoma	Six months after operation in good general health
Glazebrook, L. W. *Virginia M. Monthly*, p. 211 (May) 1895	M	55	Died suddenly while at work	At necropsy	(P.M. findings) Cerebral hemorrhage. Enlargement of tip of appendix size of pigeon egg, originating from serous coat of appendix	.....	Endothelial sarcoma	
Warren, J. C. *Brit. Med. & Surg.*, 138: 177, 1898	M	Boy	Intermittent fever and pain in right lower quadrant for one month	Small tumor at McBurney's point	Tumor at ileocecal angle and mesentery. Appendix as large as a thumb	Portion of ileum, cecum, appendix and part of mesentery removed. Anastomosis by Murphy button	Round-cell sarcoma	Postoperative result excellent. Prognosis not favorable
Davis. *J. A. M. A.*, 35: 1556, 1900	M	51	Recurrent pain in right lower quadrant	Not mentioned	Retrocecal appendix, old inflammatory adhesions measuring 1½ in. Lumen almost obliterated	Simple appendectomy	Small round-cell sarcoma	Five months after operation patient had gained 14 lbs. Working
Paterson, P. *Practitioner*, 70: 515, 1903	M	39	Uneasiness in right inguinal region for 3 mos. Acute attack and vomiting before operation	Mass tender on pressure in right inguinal fossa	Appendix much thickened, bound down by adhesions. Cecum thickened for about ¼ in.	Simple appendectomy with removal of thickened portion of cecum	Round-cell sarcoma	Patient never rallied from operation and died few hours later
Bernays. Kelly and Hurdan. Vermiform appendix. 1905, p. 759	F	29	Chronic appendicitis for one year	Hard tumor mass in right lower quadrant	Appendix 10 cm. long. Mass in distal portion. Proximal portion greatly enlarged, firm, involving adjacent part of cecum	Complete excision of cecum	Round-cell sarcoma	Recurrence after 2 years
Carwardine, T. *Brit. M. J.*, 2: 1771, 1907	F	45	Loss of weight. Pain in right inguinal fossa and diarrhea. 3 recurrent attacks in 5 months	Mass in right inguinal fossa getting larger in 2 weeks	Appendix 3½ in. long size of thumb, hard, adherent, clubbed at base, friable. Enlarged gland in close proximity	Simple appendectomy. Head of cecum and neighboring gland removed	Lympho-sarcoma	Metastasis in left lower abdomen. Death nine months after operation
de Jong, R. de Josselin, *Mitteil. a.d. Grenzgeb. d. Med. u. Chir.*, 18: 528, 1908	M	....	.....	.....	Mass at tip of appendix size of hazel nut. Fecalith in central portion. Lymph node in vicinity of appendix	Simple appendectomy	Round-cell sarcoma	

TABLE 1 (*Continued*)

	Sex	*Age*	*Symptoms*	*Physical Findings*	*Operative Findings*	*Operative Procedure*	*Pathological Report*	*Result*
Stewart. *Ann. Surg.*, 48: 607, 1908	M	35	3 recurrent attacks of "appendicitis" in course of a year	Findings usually seen in acute appendicitis	Appendix and cecum buried in what was taken to be a mass of adhesions	Simple appendectomy	Fibrosarcoma	Left the hospital 18 days after operation
Jones, E. O. *Surg. Gynec. Obst.*, 12: 131, 1911	F	26	Injured in lower abdomen when falling 4 years previously. Recurrent attacks every 6 mos. with pain in right lower quadrant, nausea	Small tumor size of walnut at McBurney's, fixed, painful. Rigidity over lower abdomen	Cecum and appendix buried in friable adhesions	Simple appendectomy. 5 days later cecum resected. Lateral anastomosis	Spindle-cell sarcoma	Four years later enjoying good health
Powers, C. A. *N. York M. J.*, 93: (Jan. 7) 1911	F	17	Attack of appendicitis, 5 weeks, lost 15 lbs.	Abdomen distended. No mass palpated	Appendix inflamed. Enlargement at middle nodule, tip size of small finger. Free fluid in abdominal cavity	Simple appendectomy	Small round-cell sarcoma	Died 10 weeks after operation, general metastasis
Wright. *Brit. M. J.*, 2: 150, 1911	M	17	Severe colicky pain in abdomen and constipation for 10 days. Vomiting day before admission	Mass right lower quadrant to level of umbilicus. Visible peristalsis	Intussusception of appendix, cecum, transverse colon, tip of appendix size of thumb. Enlarged gland	Cecum, ascending colon appendix, glands and terminal ileum removed. Lateral anastomosis	Round-cell sarcoma	4 days after operation subphrenic abscess developed. Died 1 yr. after operation
White. *Episcopal Hosp. Rep. Phila.* 1913, pp. 356–365	F	25	Pain in right lower quadrant and vomiting. One previous attack	Tenderness, rigidity over McBurney's point	Subacute appendicitis. Pale, firm area 1½ cm. in diameter at the proximal and middle third of appendix	Simple appendectomy	Round-cell sarcoma	Well 4 years after operation
Deaver, J. B. Appendicitis: Its Origin and Treatment. 1914, p. 124	M	39	Pain in right loin 2 months. Lump right side of abdomen 1 month before admission	Painless, freely movable mass size of orange, solid in right lower quadrant	Ovoid mass at tip of appendix	Simple appendectomy	Myxosarcoma of appendix and meso-appendix	Not stated
Wohl, *Ann. Surg.*, 64: 311, 1916	M	35	Pain right inguinal fossa for several weeks	Markedly tender in right inguinal fossa	Appendix increased to size of little finger, friable, extending into cecum	By manipulation a hole was made into cecum. Simple appendectomy	Round-cell sarcoma	Recurrence after 4 months. Died 7 months later
Rohdenberg. *Proc. N. Y. Path. Soc.*, 19: 2, 1919	....	4	Usual signs of acute appendicitis	.....	Appendix invaginated with cecum. Usual acute sup. inflammation	Portion of cecum resected with appendix	Lymphosarcoma	10 months after operation patient was still alive
Brinkman. St. Agnes Hosp., Phila. Nov. 16, 1920 (quoted by Friend)	....	7	3 attacks of appendicitis	.....	Hard flat growth at ileocecal valve with partial obstruction	Resection of mass	.....	Alive 9 months after operation
Goldstein. *Am. J. M. Sc.*, 161: 810–883, 1921	F	25	Stomach and bowel complaint for several years. Attacks of appendicitis. Abd. cramps and vomiting 4–5 yrs. Present attack 2 days	Mass right lower quadrant	Mass involving appendix and cecum	Simple appendectomy	Lymphosarcoma	8 months after operation patient working and well

was removed from the appendicial region before the appendix was located.

"Microscopic: Tumor mass consists of numerous spindle cells with large hyperchromatic nuclei. In some places, these are arranged in bundles. In other places they can

pressure 110/70. Examination of the abdomen showed a cauliflower growth protruding from the appendectomy incision, measuring about 10 cm. This growth was soft, necrotic, and bled very easily on manipulation. In the center of the mass was a fecal fistula. Surrounding the

TABLE 1 (*Continued*)

	Sex	*Age*	*Symptoms*	*Physical Findings*	*Operative Findings*	*Operative Procedure*	*Pathological Report*	*Result*
Friend, E. *Illinois M. J.*, p. 55 (July) 1926	F	9½	For 4 weeks intermittent pain in epigastric and umbilical region. Vomiting for 2 weeks, 3–4 times a day	Tenderness over ascending and descending colon	Dark brown fluid in per. cavity. Cecum under liver. Ap. 6 in. long, hard, size of thumb	Simple appendectomy	Lymphosarcoma of appendix and omentum	Patient died 6 weeks after operation
Haggard, C. E. *Northwest Med.*, 24: 342, 1925	M	33	Recurrent abdominal pain for last 10 yrs. Cramps for last 3 days	Local tenderness and rigidity at McBurney's point	Thickened appendix. Mass at base size of walnut	Mass of appendix and part of cecum removed. 2nd operation after recurrence. Ileocolostomy	Lymphosarcoma	Recurrence after 8 months
Capacchi, E. *Il Policlinico Sez. Chir.*, 34: 153–164 (April) 1927	M	8	Pain in right lower quadrant Occ. vomiting 1 mo. duration. (Brother of 7 died of sarcoma of cecum)	Abdomen distended. Visible peristalsis. Mass not felt due to distention and pain	Free fluid in peritoneal cavity. Fibrinous mass size of chicken egg at distal ⅓ of appendix	Simple appendectomy	Small round-cell sarcoma	Discharged cured 15 days after operation
Apitz, K. *Centralbl. f. allg. Path. u. path. Anat.*, 58: 1, 1933	M	8	Sudden attack of headache, vomiting, pain, swelling of joints	Enlarged glands angle of jaw, inguinal and axillary, enlarged spleen. Hemorrhagic stools. Diag. as sepsis	.....	Autopsy findings: Large tumor of appendix (not noticed clinically). Metastasis to liver, pancreas, kidneys	Lymphosarcoma	Patient died one month after admission

be traced to apparently an origin from smooth muscle. Scattered thruout are numerous large giant cells with single and multiple nuclei. Rudimentary blood vessels and capillaries together with many blood spaces are noted.

"Diagnosis: Spindle and giant cell sarcoma, arising probably from smooth muscle of intestine. (Leiomyosarcoma)."

Subsequently the patient developed bilateral parotitis and his temperature fluctuated from 99° to 102°F. X-ray therapy was administered to the operative wound, which continued to drain fecal material. The patient steadily became worse.

Because the patient did poorly and was of the advanced malignant type, he was transferred to the Cancer Service at Cumberland Hospital on March 3, 1933. Upon admission he was critically ill, irrational, temperature 100°F., pulse 110, respiration 28, and blood

borders of the incision was an indurated hard mass. The rest of the physical examination was essentially negative.

The blood count was: R.B.C. 2,000,000, hemoglobin 28 per cent, W.B.C. 7150, polymorphonuclears 82 per cent, lymphocytes 15 per cent, eosinophiles 1 per cent, monocytes 2 per cent. Blood Wassermann and blood chemistry reactions were negative.

Following admission to the hospital, the patient grew progressively worse and expired within thirty-six hours. A post-mortem examination was made by the pathologist, Dr. M. J. Fein. Abdominal examination showed the malignancy limited to the cecal area. A portion of the cecum was fixed to the outer abdominal wall. The appendix was not present. The mesentery at this part was thickened and one portion was found to contain an abscess about the size of a lemon, which contained thick,

white purulent material. There were no evidences of other metastases or extensions of the disease, but there was evidence of systemic bronchopneumonia, chronic venous congestion of spleen and liver, pyelonephrosis, hypertrophy (adenomatous) of prostate gland."

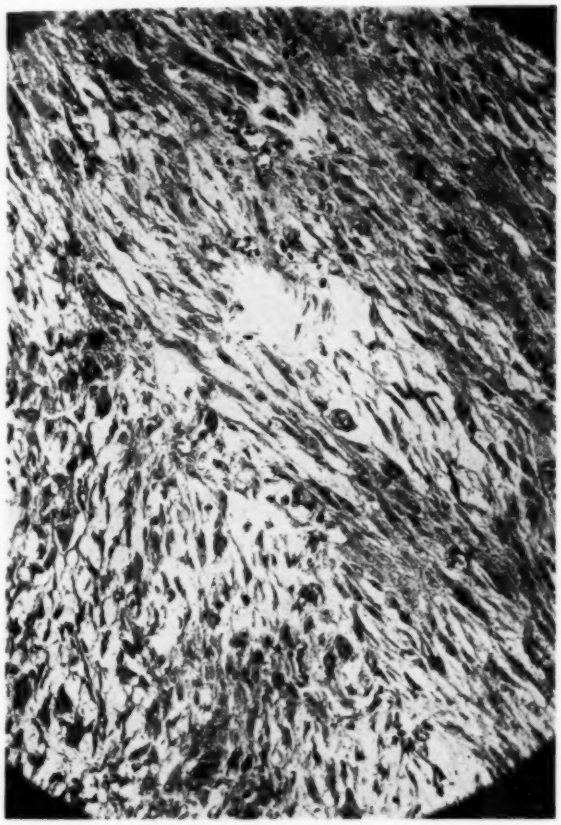


Fig. 1. Leiomyosarcoma, low power.

Fig. 2. Leiomyosarcoma, high power.

septic invasion of the other organs.

The microscopic report of the tumor by Dr. Fein was as follows:

"There is a neoplasm which is made of cells with the most extraordinary variation. Small and large cells, including giant forms, are mixed together. The nuclei are numerous, are larger than usual, and have blunt and rounded ends with hyperchromatosis and considerable mitosis. A Van Gieson stain shows these tumefaction cells are of muscle origin."

The final autopsy report was:

"Leiomyosarcoma of cecum, chronic adhesions, pericarditis, focal interstitial myocarditis,

CONCLUSION

Sarcoma of the appendix is rare; leiomyosarcoma of the appendix is extremely rare.

Twenty-two cases of sarcoma reported in the literature are reviewed herein.

The symptoms of sarcoma of the appendix are not distinctive and diagnosis is not possible before operation.

A case of leiomyosarcoma is described.

Treatment is surgical, with irradiation administered postoperatively.

Prognosis is always grave and the outcome usually rapidly fatal.

LIVING SUTURES

AS A SUPPLEMENT TO PLASTIC BONE SURGERY*

CHAS. MURRAY GRATZ, M.D. AND RICHARD P. ROBISON, M.D.

NEW YORK CITY

THE successful transplantation of fibrous tissues has resulted from basically sound research and wide clinical observation. The ability of these tissues when used in the form of sutures to grow solidly to bone, muscle and fascia, *if properly coaptated*, has been fairly definitely established and makes unnecessary further reiteration of their advantages over absorbable and non-absorbable sutures in selected cases.

FIG. 1. X-ray of pelvis October 1, 1931. Note separation of symphysis pubis; downward displacement of right side of pelvis; fracture at junction of ramus of ischium and ramus of pubis; fracture at junction of ramus of ischium with tuberosity of ischium.

It would, therefore, seem logical to assume that physiologically living sutures should be a valuable supplement in certain cases requiring plastic bone surgery, where by forming a scaffold over or through the component host and scion tissues, a more expeditious bony union might result. In going over the literature, Patterson[1] reports the use of fascia lata in 14 cases of fractures and dislocations; 5 cases are reported in full and good results were obtained in the entire series. In one case infection occurred, but the suture survived the infection for over two weeks. In the 5 cases fully reported fascia lata from the thigh was used and in one case a fragment of bone was used as a modified graft with good results.

The use of a maximum amount of autogenous tissue with an equable decrease in foreign material is indicative of the present trend in surgery. In devising a technique, however, the exponents of this principle encounter obstacles. The primary difficulty is the frequent necessity of two extra incisions, one to secure the osseous graft and the other to obtain the fascial transplant.

By virtue of the extra incisions the severity of the operation is increased; the patient may take exception to too many incisions, and unless care is exercised the technique may become unduly complicated.

* From the Departments of Orthopedic Surgery, New York Post-Graduate Hospital—Columbia University. (Case report from Broad Street Hospital.) Presented before the Section on Orthopedic Surgery, N. Y. Academy of Medicine.

The elimination of one incision is possible in many cases by a careful study of the anatomical structures involved, and in the case herewith reported, it was most easily applied. Should the tensile strength of a periosteal suture suffice, periosteum from the site of the osseous graft is often readily available.

Fig. 2. *X*-ray October 1, 1931. Supracondylar fracture with marked overriding and lateral displacement of fragments with large spicule of bone in upper part of fracture widely separating fragments.

Fig. 3. *X*-rays May 16, 1933. End-result.

In operations involving the knee the fibrous tissue necessary may be obtained by the incision exposing the involved parts as illustrated by Ober's technique.[2] In certain spinal cases, erector spinae fascia has been successfully used by the author to anchor spinal grafts.

In addition to the choice of correct structures to facilitate permanent repair, a definite effort should be made to obtain the maximum strength of internal fixation. For this reason it is necessary to possess at least a fair working knowledge of the tensile strength of fibrous tissues,[3] and the selection should be guided not only by the type but by the size of the suture necessary.

It is my belief that the operative procedure frequently used has not afforded the greatest strength of internal fixation because of the insufficient attention given to the anchoring of the fascial transplants. A very careful study of the technique as reported in the literature would seem to indicate that this may account for some of the failures reported. If the transplants themselves depend for anchorage on absorbable or non-absorbable sutures, this technique would seem to be less advantageous than one in which the entire strain is borne by the sutures themselves.[4]

The ultimate fate of living sutures is always of extreme interest and the opportunity to examine them clinically after they have been in place many years is unfortunately rare. The observations of Bunnell,[5] based on records of 461 free grafts of fascia and tendon are of great interest. Bunnell states: "A tendon or fascial graft which is given the function of resisting repeated tension will hypertrophy in response to the demand. If, however, the force to which it is subjected is too great and too constant, the tissue, whether natural or a graft, will atrophy and yield."

The dividing line between these two extremes: hypertrophy and atrophy, is in all probability the safe working load of the transplanted tissues used. Physiologically,

if the transplant has to bear a load in excess of this, the behavior of the tissues under tension would appear to indicate a dis-

In the case report which follows two fascia lata sutures, 3/8 inch in width, were used to supplement a bone peg. By the

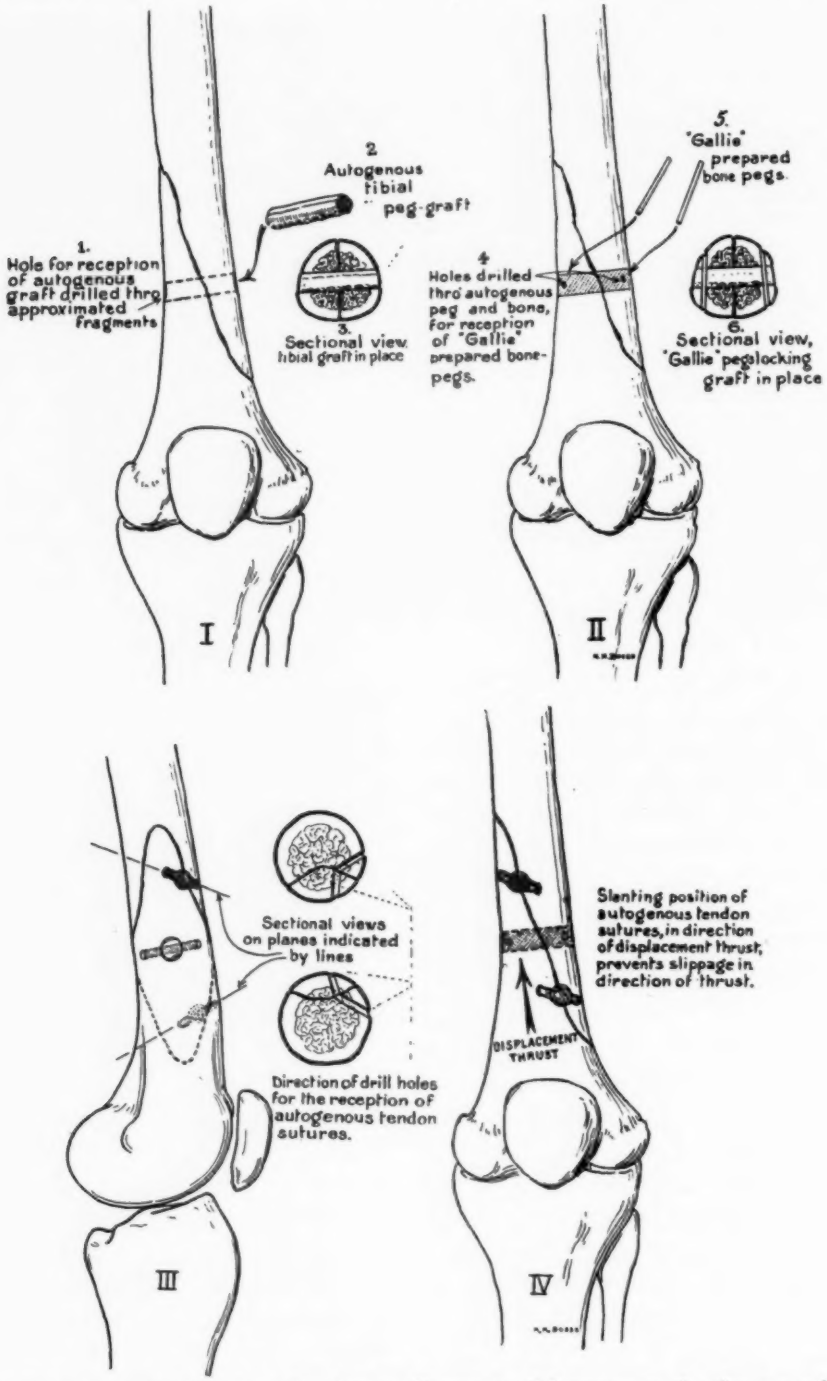

1.
Hole for reception of autogenous graft drilled thro approximated fragments
2
Autogenous tibial peg-graft
3.
Sectional view tibial graft in place
I
4
Holes drilled thro autogenous peg and bone, for reception of "Gallie" prepared bone-pegs.
5.
"Gallie" prepared bone pegs.
6.
Sectional view, "Gallie" pegs locking graft in place
II
Sectional views on planes indicated by lines
Direction of drill holes for the reception of autogenous tendon sutures.
III
Slanting position of autogenous tendon sutures, in direction of displacement thrust, prevents slippage in direction of thrust.
DISPLACEMENT THRUST
IV

FIG. 4. Technique. I. Anteroposterior view showing re-alignment of fragments; site for reception of graft with sectional view. II. Anteroposterior view showing site of Gallie pins (sectional view). III. Lateral and sectional views showing technique. IV. Anteroposterior view of completed technique.

integration of the fibers. This would account for the phenomena of atrophy as noted.

calculations previously made the sutures alone should withstand a safe tension of 64.4 lbs.[3] Enumeration of these factors

may clarify a few problems to be met in this type of work.

CASE REPORT

L. F., male, aged forty-nine years, stock broker, was first seen in Broad Street Hospital on September 29, 1931. The patient had been picked up by the ambulance after falling two stories. He was unconscious and semi-moribund. There were all the signs of compound fracture of the lower third of the right femur; exquisite pain over the pelvis, particularly over the crest of the ilium; marked swelling of the left ankle; a laceration ½ inch long over the left eyebrow. The heart sounds were very faint, the reflexes sluggish. Blood pressure 60/35.

Emergency treatment for shock was given and the area of compound fracture thoroughly cleaned with temporary splinting of the involved areas. It was noted that there was a 1¾ inch shortening of the right leg as compared with the left.

The working diagnosis, after indicated consultations and *x*-ray examinations, was as follows: (1) Compound supracondylar fracture of the lower third of the right femur; (2) multiple fracture of the pelvis; (3) fracture of both malleoli of the left ankle; (4) cerebral concussion.

Details of the first two are shown in Figures 1 and 2.

The multiplicity of the fractures and the fact that they were all involved in weight bearing necessitated a carefully planned sequence of treatment.

The pelvis received first consideration. Very fortunately, in spite of the fact that there was a 3 cm. separation of the symphysis pubis and a complete fracture of the pubis and ischium, there was no involvement of the bladder.

A linen hammock about 14 inches wide was placed beneath the pelvis, extending from the lower lumbar region of the spine to beneath the buttocks; each side of this sling was fastened by means of a pulley to a Balkan frame and 20 lb. traction used on either side. The result obtained is shown in Figure 3.

The next in order was the femur. The area of compound fracture had been thoroughly cleaned and prepared when the patient was first seen, and infection was avoided. Russell traction was selected and the foot of the bed elevated. We considered that this method in conjunction with the sling was the simplest and most effective in getting satisfactory results on this case as it avoided any countertraction against the injured pelvis.

Fig. 5. *X*-rays December 17, 1931. Lateral view showing contour of femur and bone peg.

The bi-malleolar fracture of the left ankle was reduced and held in suitable position by a cast and good result obtained.

Of the three groups of fractures, satisfactory results had been obtained by conservative methods in two, but further work was necessary on the third, i.e. the femur. Open operation was decided upon. Inasmuch as this treatment would necessitate the use of a plaster spica until healing was completed, operation was delayed until satisfactory reduction of the fracture of the pelvis was obtained.

Thorough medical examination disclosed three abscessed teeth which were removed before operation.

Fig. 6. *X*-rays May 16, 1933. End-result.

The operation of choice was an autogenous tibial bone peg, supplemented by living sutures. The latter were obtained from the thigh of the same leg and the technique used for the operation is graphically illustrated in Figure 4.

The operation was done under general anesthesia on November 4, 1931. The patient was placed on the Albee table with sufficient traction to reduce the fracture. A lateral incision exposed the fascia lata; two sutures about 3/8 inch in width removed; the incision deepened to expose the osseous structure; spicule of bone and fibrous tissue found between the fragments removed and the fracture approximated and held in position by suitable clamps. The reamer designed by Albee for his bone peg operation was used to drill a hole through the central portion of the fractured area.

The bone peg taken from the crest of the tibia of the same side was prepared by using the Albee mill and fitted accurately for reception in the femur. To counteract muscular pull, which might cause angulation of the graft, Gallie bone pins were placed through each end of the graft. The fascia lata sutures were placed one above and one below the bone peg and tied with a reinforced square knot, sutured to the periosteum and the ends which had been traumatized in their transplantation carefully removed. The suture threader was of assistance in placing the living sutures.[6]

Closure was made in the usual manner and a plaster spica applied. The postoperative course was uneventful. The immediate postoperative *x*-rays showed good reduction. Later *x*-rays showed an upward displacement of the distal fragment with a slight slipping of the bone graft. Whether this was due to the prepared bone peg breaking or shear through the graft of the autogenous bone, is purely a matter of conjecture. However, the clinical course of the case would seem to indicate that the living sutures held and prevented further overriding of the fragments.

X-rays taken December 17, 1931 when the first spica was removed are shown (Fig. 5). The second spica was removed and weight

bearing with the aid of a brace started January 20, 1932. Physiotherapy was instituted and the convalescence was uneventful. The end-result is shown in Figure 6.

The downward displacement due to the fracture of the pelvis compensated for the slight overriding at the site of operation of the right femur, with the result that there was no functional shortening.

May 19, 1933, the patient was able to walk without a limp and without the aid of any support.

SUMMARY

1. Living sutures in the case reported and in previous cases reviewed have been successfully used as a supplement to plastic bone surgery.

2. The operation was accomplished by a comparatively simple technique and the living sutures were obtained from the incision exposing the site of operation.

3. The technique was so devised that the full strength and elasticity of the sutures were utilized and they were used within their safe working load. The clinical course of the case indicates that although the bone peg gave the living sutures were sufficiently strong to prevent further overriding of the fragments.

4. Callus formation may have been assisted by using one autogenous bone peg and two autogenous sutures, the latter being tied in a loop which actually gave five scaffolds of autogenous mesodermic material bridging the area of fracture.

Comment: The strength of internal fixation may be definitely increased by anatomical and mechanical study of the structures involved, and by so doing the operation may be planned so that the safe working load of the transplant is considered and the danger of atrophy correspondingly decreased.

I wish to acknowledge with thanks Dr. Fred H. Albee's consultation and advice.

REFERENCES

1. Patterson, R. H. Internal fixation of fractures and dislocations by use of human fascia lata. *Am. Surg.*, 88: 879–84, 1928.
2. Ober, F. R. Fracture of patella: a new operation. *J. Bone & Joint Surg.*, 14: 640–643, 1932.
3. Gratz, C. M. Tensile strength and elasticity tests on human fascia lata. *J. Bone & Joint Surg.*, 13: 334–340, 1931.
4. Gratz, C. M. The use of fasciae in reconstructive and plastic surgery with special reference to operative technique. *Ann. Surg.*, 99: 241–245, 1934.
5. Bunnell, S. Discussion of Haas, S. L. Free fascial grafts; union with muscle; cases. *Calif. & Western Med.*, 32: 387–93, 1930.
6. Gratz, C. M. New instruments for living sutures. Am. J. Surg., n.s. 13: 81–82, 1931.

ACUTE PANCREATITIS

OCCURRING SIMULTANEOUSLY IN MOTHER AND DAUGHTER

W. KENNETH JENNINGS, M.D.

WINNETKA, ILL.

RECOGNITION of a disease entity is usually followed by improved treatment and lowered mortality. This is especially true of conditions amenable to surgery. Acute hemorrhagic pancreatitis offers an exception to this general rule as attested by the slight change in the mortality rate over the period of years since its first recognition.

Körte[1] in 1911 published a series of 103 cases in which the mortality rate was 60 per cent. Guleke's[2] 437 cases published in 1924 showed a mortality of 52.2 per cent and in 1927 Schmieden and Sebening[3] collected a series of 1278 cases in which the mortality was 51.2 per cent. DeTakats and Mackenzie's[4] 30 cases collected from the Evanston and Wesley Memorial Hospitals gave a mortality of 36.6 per cent.

At the present time, then, we must regard the mortality of this disease as approximately 50 per cent.

The etiology of pancreatitis has never been definitely established although several theories as to its cause have been advanced. Of these the most commonly accepted are (1) extension of infection to the pancreas from the biliary system through the lymphatics. This was first announced by Klipfel[5] in 1899. Maugeret[6] in 1908 published anatomical and clinical evidence supporting the lymphatic theory. (2) Infection of the pancreas through the blood stream. In a series of carefully planned experiments on cats Kaufman[7] was unable to find any evidence supporting the lymphatic theory but was able to produce pathological changes in the pancreas after injecting staphylococci into the portal vein. He proved this to be due to a bacteriemia rather than a spread through the lymphatics. (3) Obstruction of the common duct near the ampulla of Vater with consequent backing up of infected bile along the pancreatic duct. Opie[8] in 1908 collected 43 cases in which gallstones and acute pancreatitis were associated and in 9 of which a calculus had lodged near the termination of the bile duct.

Hans Stocker[9] recently published a series of 48 cases of acute pancreatitis with associated cholelithiasis in 10 of which there was evidence of a disturbance of the vegetative nervous system. This led him to conclude that imbalance between the vagus and the sympathetic nervous system causes a dyskinesia, or disturbance in the muscle tone of the gall-bladder system, which may result in bile being forced back into the pancreatic duct.

Wolfer[10] in a series of recent experiments on dogs, has shown that the presence of pancreatic juice in the common duct or gall bladder for a short period of time produces a typical pathological picture of chronic cholecystitis. He further demonstrates that in the dog when pancreatic juice is conveyed into the terminal end of the common duct it can find its way into the gall bladder. This suggests that in cases of pancreatitis associated with biliary tract disease the latter may be secondary. Sieworth[11] reports a case of pancreatic necrosis with congenital absence of the gall bladder.

That the pancreas is an organ not easily infected has been clearly demonstrated by Hinton[12] who failed to find any evidence of pancreatic disease in a series of 66 necropsies, 16 of which were performed on patients who had died with acute peritonitis.

So far as symptomatology is concerned excruciating epigastric pain associated with vomiting and the usual symptoms of shock are the ones most commonly manifest. A history suggesting chronic biliary tract disease is the rule. It is not uncommon for an attack of acute hemorrhagic pancreatitis to assume an apoplectiform character, the sufferer falling to the floor with the first agonizing pain.

Jones[13] emphasizes the fact that the pain in pancreatitis usually extends across the upper abdomen and may be most pronounced in the left flank if there is involvement of the tail of the pancreas. Chouquard's[14] case is of interest in that the pain and paramount tenderness were confined to the lower right quadrant. A preoperative diagnosis was made of ruptured ectopic pregnancy.

Any discussion regarding the diagnosis of acute pancreatitis should be prefaced with a recognition of the fact that few cases ever are diagnosed before operation. In DeTakats and Mackenzie's[4] 30 collected cases not one was diagnosed preoperatively.

At operation the gross changes in the pancreas are often striking. The pancreas is usually enlarged two or three times the normal size and may be hard in milder forms or soft in the more severe types. The surface may show opaque, whitish areas of fat necrosis, extensive areas of hemorrhage, or may be black and gangrenous. The presence of serosanguinous fluid in the lesser peritoneal sac is characteristic. Fat necrosis is most abundant in the vicinity of the pancreas but may be scattered widely over the mesentery and omentum.[15]

According to Mosher fat necrosis is due to the action of the fat-splitting enzyme of the pancreas. The neutral fat is broken down into the glycerine and fatty acids and the latter combine with calcium to form an insoluble soap which is precipitated. The patchy distribution is best explained by lymphatic transmission of the liberated lipase. Boyd[15] emphasizes that "fat necrosis always indicates a coexisting pancreatic necrosis although the pancreas sometimes appears normal." However, evidence of fat necrosis may not be present.

A history of a sudden attack of agonizing epigastric pain associated with nausea and vomiting, and the physical findings of upper abdominal tenderness, rapid, thready pulse and somewhat cyanotic appearance should suggest pancreatitis. Abdominal rigidity is usually localized to the epigastrium. Some surgeons describe a "doughy" abdomen as characteristic of the peritonitis which sometimes follows acute pancreatitis. A tumor mass in the region of the pancreas when palpated is of significance. The leucocyte count is usually elevated above 15,000 per cubic millimeter. Rapid dehydration is the rule and may give abnormally high values for the hemoglobin and the erythrocyte count.

Skoog[16] and DeTakats[4] suggest the use of the diastase test as an important diagnostic aid. These writers feel that while an increased amount of diastase in the urine may result from other acute abdominal conditions a negative test during the first thirty-six hours of illness absolutely rules out the possibility of pancreatic disease.

The condition for which acute pancreatitis is most commonly mistaken is acute cholecystitis. Perforation of the gall bladder is the diagnosis frequently considered. Jones[13] states that gallstones seldom cause vomiting. In reviewing 70 recent proved cases of acute cholecystitis at the Evanston Hospital I found the incidence of vomiting early in an attack to be approximately 90 per cent. Both Judd[17] and Lahey[18] feel that rupture of the gall bladder is rare and that it almost never happens during the first few days of an attack owing to the thickness and elasticity of its walls.

Other conditions which acute pancreatitis may simulate are perforated peptic ulcer and acute intestinal obstruction.

The treatment of pancreatic necrosis has advanced little more than has knowledge concerning its diagnosis. At the present time there exists considerable divergence of opinion among authorities as to the proper surgical disposition of such cases.

Jones[13] believes that drainage of the capsule of the pancreas together with drainage to the common duct is the best procedure but regards drainage of the pancreas itself as of first importance. Archibald[19] contends that drainage of the common duct should be accomplished if possible, or, the patient's condition contraindicating, a cholecystostomy done. He does not feel that it is necessary to drain the pancreas itself.

Haynes[20] reports 5 cases with recovery in which he employed a new method of drainage of the pancreas. It consists essentially in separating a portion of the head of the pancreas from its duodenal attachment by blunt dissection and inserting drains through this opening into the retropancreatic space.

Treatment in the 2 cases under consideration was adapted to suit conditions found. In the instance of the mother a cholecystostomy alone was done. The pancreas did not appear under sufficient tension to warrant drainage of its capsule. In the case of the daughter drainage was established only to the pancreas itself as it was thought that the patient's condition would not permit any further operative procedure. The marked induration and swelling involving the pancreas seemed to indicate direct drainage.

Case 1. Mrs. S. H., aged seventy-six, was suddenly seized with severe pain in the right upper quadrant radiating to the back and right shoulder. This was closely followed by nausea and vomiting. When seen an hour later there was marked tenderness over the right upper quadrant but little if any muscle rigidity. The temperature was 99°F. and the white blood count 12,000. Two hypodermic injections of morphine, grains ¼ each, were necessary for temporary relief from pain.

There was no history of susceptibility to dyspepsia and the patient denied having had any similar attacks in the past. She had borne eight children. A diagnosis was made of gallstone colic. During the next twelve hours she continued to have considerable distress and hospitalization was advised. After four days of persistent pain and increasing upper abdominal tenderness the white blood count had increased to 21,400. The temperature curve was practically unchanged. Owing to the increasing leucocytosis an operation was advised. At operation the peritoneal cavity was found to contain a small amount of serous fluid. The gall bladder was markedly distended, with a thickened, indurated wall which in the region of the neck was covered with fibrin, suggesting infection from outside. Numerous adhesions brought the gall bladder into intimate relationship with the omentum and neighboring structures. The head of the pancreas was exposed and appeared acutely inflamed. There was moderate thickening but no evidence was seen of fat necrosis. A cholecystostomy was done and two cigarette drains placed around the gall bladder.

The patient's convalescence was stormy but she was able to return to her home on her twenty-fifth postoperative day, the cholecystostomy drain having been removed on the thirteenth postoperative day. Except for one mild attack of epigastric pain, lasting four days, her subsequent course has been symptom free and she leads a fairly active life.

Case 11. Three weeks after her mother's operation a daughter, Miss V. H., aged forty-three, gave a history of having had an attack of acute upper abdominal pain associated with jaundice four months previously. At that time she was confined to bed for nine days. The pain was most severe in the right upper quadrant and at times radiated to the right shoulder. Since then she had suffered dyspepsia almost daily and was unable to eat anything except liquids and soft foods. She lost 24 lbs. in four months.

An examination revealed abdominal tenderness which was definitely localized to the region just to the right of the umbilicus. It was thought that a tender mass was palpated which seemed a little low for the gall bladder. There was no abdominal rigidity. She was admitted to the hospital and a gastrointestinal study was made. X-ray examination of the stomach and intestines failed to reveal any abnormality. A cholecystogram indicated a poorly functioning gall bladder which contained many small stones. Bile was found in the urine, the white blood count was 7800 and there was no elevation in temperature during her stay in the hospital.

In consideration of the history and confirmatory findings a diagnosis was made of

chronic cholecystitis with associated cholelithiasis and a cholecystectomy was advised. The patient elected to postpone the operation until a later date.

Three days after her discharge from the hospital she suffered a sudden attack of excruciating pain in the right upper quadrant and vomited. When seen an half hour later there was marked tenderness in the right upper quadrant and the entire abdomen was soft. The temperature was 99.6°F. Two hypodermic injections of morphine were necessary for partial relief from the pain. During the day she continued to suffer pain but was much more comfortable. The temperature remained in the neighborhood of 99°F. When visited the following morning she was found to be in profound shock with a temperature of 92°F. and a rapid, thready pulse which was barely perceptible. The extremities were cold and there was slight cyanosis of the skin. Examination of the abdomen revealed a generalized muscle rigidity and tenderness. The white blood count was 23,000. She was immediately taken to the Evanston Hospital by ambulance where she received 2000 c.c. of 5 per cent dextrose solution. Following this the blood pressure rose from 80/40 to 90/68. A blood transfusion was given, the patient receiving 500 c.c. of citrated blood. The blood pressure rose to 122/94, but it was thought the patient's condition was too critical to justify an operation. During the next twenty-four hours she received two more transfusions of blood to which she responded very well, the blood pressure rising to 160 systolic and the quality of the pulse showing marked improvement. It was then felt that an abdominal exploration was advisable. Preoperative diagnosis of perforated gall bladder was made and the patient taken to the operating room. The abdomen was opened through a high right paramedian incision. Upon opening the peritoneal cavity a large amount of blood-tinged fluid escaped under considerable pressure. The gall bladder was then located and was found to be free from evident inflammatory reaction. In the region of the pancreas, in which flecks were seen suggesting fat necrosis, a hard inflamed tumor mass the size of a small orange was discovered which upon closer examination was found to be the head of the pancreas. An incision was made into the mass which bled freely. The wound was then packed with gauze and a battery of cigarette drains placed along side. The patient's condition seemed none too good at this point and the abdomen was quickly closed.

Convalescence was stormy and the patient was unable to retain any fluids by mouth for a week. From 1500 to 3000 c.c. of 5 per cent dextrose Ringer's solution was given subcutaneously every day for the first twelve postoperative days. At the end of this time she was able to retain a soft diet. On the fourteenth postoperative day she complained of pain in the left chest and an elevation in the respiratory rate was noted. A portable *x*-ray film revealed a diffuse clouding of the left chest. This was interpreted as a pleural effusion. On the twentieth postoperative day a thoracentesis was done and 200 c.c. of straw-colored fluid obtained. A rising temperature and diminished amount of discharge from the wound prompted a digital exploration of the sinus tract on the thirtieth postoperative day. No abscess pocket was found but drainage was more liberal and the patient's condition seemed improved thereafter. Three weeks after the operation vomiting again became a prominent symptom and by the thirty-first postoperative day she was unable to retain anything by mouth. In view of this a jejunostomy was performed on the thirty-second postoperative day and a mushroom catheter was sutured into the bowel. The patient's diet was Scott's pabulum together with certain supplementary vitamins which were injected through the enterostomy tube for a period of twelve days, at the end of which time she was able to retain a normal amount of fluids and food in the stomach. The tube was then drawn up and cut close to the mushroom, the latter passing through the bowel two days later. The jejunostomy wound closed spontaneously after eight days of drainage.

The patient was discharged from the hospital in an ambulance on the fifty-eighth postoperative day. It has now been seventy-seven days since her operation. She does a fair amount of walking, is able to take care of herself, is taking a moderate diet and is gaining weight. She has been absolutely symptom free since her discharge from the hospital.

REFERENCES

1. Körte, W. Die chirurgischen Krankheiten und die Verletzungen des Pankreas. *Deutsch. Chir.*, Vol. 14, Jena, Enke, 1898.

[For Remainder of References see p. 373.]

EPITHELIOMA DEVELOPING ON A VARICOSE ULCER*

SIDNEY RUBENFELD, M.D.

NEW YORK CITY

IN the course of examination and treatment of over 9000 patients in the Radiation Therapy Service at Bellevue Hospital during the past ten years, but one case of a definite epithelioma developing on a varicose ulcer has been seen. Broders[1] listed 12 instances of epithelioma of the legs in a series of 2000 epitheliomas; and D'Assis[2] collected 17 cases of leg malignancies in 6766 epitheliomas and only one instance was noted on varicose ulcers. This evidence of the relative infrequency of such a lesion is the reason for, and, we believe, the justification of this report. In the review of literature up to 1925, Knox[3] found 59 reported cases, and to this list, added 2 of her own. D'Assis in 1926 recorded 17 cases of epithelioma of the leg, and in only one instance was it apparent that a varicose ulcer formed the basis for the malignancy. In 1932, Tenopyr and Silverman[5] reported 19 epitheliomas of the leg amongst 1000 chronic leg ulcerations seen by them and of these, only 4 were found to have arisen on the sites of ulcers which had existed for ten to twenty years. Lang[4] in 1932 added one case in which the ulceration was present for two years before a biopsy identified its true nature. It is of uncommon interest to note that while varicose ulcer is so very frequent, the occurrence of carcinoma in this type of ulcer is indeed a rarity.

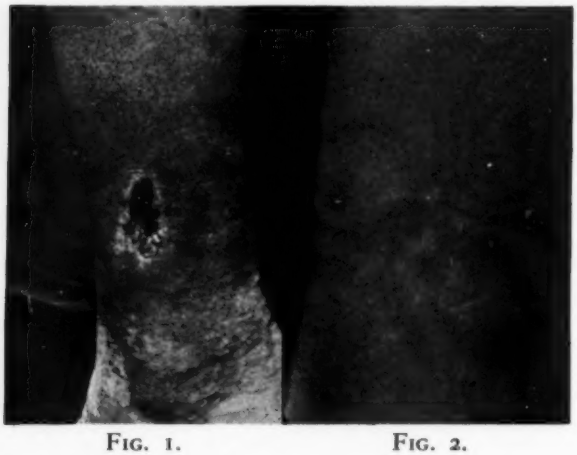


FIG. 1.

FIG. 2.

CASE HISTORY

Mrs. T. G., aged forty-five, white, was admitted to our clinic in September, 1931. For many years she had suffered with varicose veins of both extremities, and in 1927, noted that an ulceration appeared on the right leg. For four years before admission to the hospital occasional rest in bed was always an efficacious remedy in causing a disappearance of the ulcer which, however, recurred from time to time. In April, 1931, intravenous therapy was suggested and carried out but no effective result was achieved after this form of treatment was employed.

Because the ulceration failed to heal after the injection therapy procedure had been completed, and because the ulcer advanced and appeared suspiciously malignant, the patient was referred to the Radiation Therapy Service.

Examination on admission showed a robust and healthy looking female. The local lesion situated on the lateral aspect of the lower third of the right leg was an excavated ulceration measuring 4 by 1.5 mm. (Fig. 1), the base of which was made up of bloody, necrotic, sloughing granules; the edges were rolled, elevated, whitish, and very distinctly indurated. The surrounding areas exhibited a dark purplish pigmentation, and presented numerous coursing varicose veins. On the other leg there were also many varicosities but no ulcerations. Otherwise, the patient revealed no abnormalities.

* From the Surgical Service of Dr. A. M. Wright and the Radiation Service of Dr. Ira I. Kaplan, Bellevue Hospital, New York City.

A biopsy was taken of the ulcerated edge and was reported by Dr. Douglas Symmers as basal-cell epithelioma.

Radiation therapy was advised and treatment was administered in the form of wax mold constructed to hold 4–5 mg. tubes of radium element filtered through 1.5 mm. of platinum. The mold was placed over the lesion at a 1 cm. distance, and the dose given was 2000 mg. hr. over a period of four days.

The ulcer healed completely in two months, and has remained healed for two and one-half years (Fig. 2).

SUMMARY

While transition of a varicose ulcer to an epithelioma is rare, it should be borne in mind when persistent ulceration occurs which does not heal under the usual therapeutic measures employed.

Radiation therapy is the method of choice for the treatment of varicose ulcer epithelioma.

A case is reported showing the result of such treatment.

Photographs of the lesion before and after treatment are shown.

REFERENCES

1. Broders. Basal cell epithelioma. *J. A. M. A.*, 72: 856 (March) 1919.
2. D'Assis. Cutaneous carcinoma of the lower extremities. *Ann. Surg.*, 83: 663 (May) 1926.
3. Knox, L. C. Epithelioma and the chronic varicose ulcer. *J. A. M. A.*, 85: 1046, 1925.
4. Lang, C. Hautkarzinom das zwei Jahre Langals Varixknoten angeseher Wurde. *Munchen Med.*, 79: 1803 (Nov.) 1932.
5. Tenopyr and Silverman. Relation of chronic varicose ulcer to epithelioma. *Ann. Surg.*, 95: 754 (May) 1932.

REFERENCES OF DR. JENNINGS*

2. Grass, O., and Guleke, N. Die Erkrankungen des Pankreas. Berlin, Springer, 1924.
3. Schmieden, V., and Sebening, W. Surgery of the pancreas. *Surg. Gynec. Obst.*, 46: 735, 1928.
4. DeTakats, G., and Mackenzie, W. D. Acute pancreatic necrosis and its sequelae. *Ann. Surg.*, 96: 418 (Sept.) 1932.
5. Klipfel. The lymphatic theory of pancreatitis. *Arch. gén. de méd.* (July) 1899.
6. Maugeret. Paris Thèse, 1908.
7. Kaufman, M. Experimental study of lymphatic theory of pancreatitis. *Surg. Gynec. Obst.*, 44: 15 (Jan.) 1927.
8. Deaver and Ashhurst. Surgery of Upper Abdomen. Phila., Balkiston, 1921.
9. Stocker, H. Disturbances of motility of bile ducts as a precursor of acute necrosis of pancreas. *Deutsche Ztschr. f. Chir.*, 237: 418 (Sept.) 1932.
10. Wolfer, J. A. The role of pancreatic juice in the production of gall bladder disease. *Surg. Gynec. Obst.*, 53: 433 (Oct.) 1931.
11. Sieworth, W. S. Necrosis of pancreas with congenital absence of gall bladder. *Illinois M. J.*, p. 327 (April) 1933.
12. Hinton, J. W. Chronic pancreatitis in routine necropsy examinations. *Ann. Surg.*, 87: 637 (April) 1928.
13. Cabot. Choledocholithiasis; acute hemorrhagic pancreatitis. *New England J. Med.*, 208: 499 (March) 1933.
14. Chouquard, L. Case of generalized peritonitis from acute pancreatitis. *Schweiz. Med. Wchnschr.*, 56: 454 (May 15) 1926.
15. Boyd's Surgical Pathology. Phila., Saunders, 1925.
16. Skoog, T. Diastase—Untersuchungen im Harn bei acuter Erkrankungen der Bauckhohle. *Chirurg.* 1; 305, 1929.
17. Judd, E. S., and Phillips, J. Perforation of gall bladder. *Ann. Surg.*, 98: 359 (Sept.) 1933.
18. Lahey, F. H. Acute and subacute cholecystitis. *Surg. Clin. N. America*, p. 595 (June) 1933.
19. Archibald, E. Some observations on the diagnosis and treatment of subacute and chronic pancreatitis. *Canadian M. A. J.*, 3: 87 (Feb.) 1913.
20. Haynes, H. H. A new surgical procedure for acute pancreatitis: report of six cases. *Arch. Surg.*, 26: 288 (Feb.) 1933.

* Continued from p. 371.

ACTINOMYCOSIS OF THE FEMALE GENITAL ORGANS

VIRGIL S. COUNSELLER, M.D., AND M. TISCHER HOERNER, M.D.

ROCHESTER, MINN.

ACTINOMYCOSIS has long been known as a disease which although primary in the alimentary tract may involve almost any organ of the body secondarily. Langenbeck, in 1845, was the first to note the "sulphur grain" bodies in an abscess, but Hartz really gave the disease its name. Bollinger then demonstrated that the vegetable organism of the ray fungus was responsible for lumpy jaw in cattle and, finally, in 1878, Israel recognized the same etiologic agent as the cause of the disease in man.

Although many cases of the disease have been reported since that time, actinomycosis of the female genital organs may still be considered as a rare condition. Illich reviewed 421 cases of actinomycosis in 21 per cent of which the involvement was abdominal, but no mention was made of involvement of female genital organs in this group nor in 87 cases reviewed by Horbitz and Grandel. Robinson found only 19 cases in the literature up to 1919 in which there was definite involvement of the genital tract but, in 1925, Helwig reported 14 additional cases. Since publication of these papers, actinomycosis of the female genital organs has been more widely recognized, for in a survey conducted in 1933, Ahltorp was able to report 70 cases all told, but comparatively few of this number were found in the United States. Sanford made a thorough study of actinomycosis in this country in 1925, extending his search to records of bureaus of public health and of hospitals as well as to cases reported in the literature, and he found just 16 cases in which the female pelvis had been involved. However, the reports on 7 of these cases were too incomplete to determine whether or not the genital organs had been affected. Subsequent to this review, 3 cases of right and one of left actinomycotic tubo-ovarian abscess had been reported.

There is much controversy over the manner in which the organism gains access to the genital viscera of the female, but the majority of investigators favor the idea that the intestine is the primary site of infection. Stein expressed the belief that Actinomyces bovis sets up an insignificant lesion in the intestinal mucosa and burrows through the wall, eventually invading the pelvic organs. Draper and Studdiford stated that the appendix bears the same relation to abdominal actinomycosis as the carious tooth does to the cervicofacial type of the disease. Of the 33 cases of actinomycosis involving the genital tract reported by Helwig, in 20 the condition definitely was proved to have originated in the intestine, and in the remainder, primary lesions of the intestine were suspected. He attributed actinomycosis of the right side of the pelvis to lesions of the cecum or appendix, and similar abscesses in the left side of the pelvis to involvement of the sigmoid. Actinomycotic infection of pelvic viscera through the vagina was doubted by Wagner and Hüffer. On the other hand Poncet and Bérard admitted the possibility that actinomycosis could be introduced on a foreign body to the urethra or vagina, and found one case of urethral involvement. Haselhorst observed actinomycosis following artificial abortion, and Tietze detected genital lesions caused by the use of an intra-uterine pessary. In addition, both Mitra and Warthin noted primary actinomycosis of the uterus and vagina, which was confirmed at necropsy. Thus,

these latter findings suggest that the genital tract itself may also be a portal of entry to actinomycotic infection.

It is the purpose of this paper to report cases of this disease, 2 of which were mentioned by Sanford, that have been encountered at The Mayo Clinic.

Case I. (Mentioned by Sanford) A woman, aged twenty-one years, had suffered a sudden attack of generalized abdominal pain in December, 1918, which finally had become localized in the right lower quadrant. She had vomited several times and had had a fever. One week later a tube had been inserted into a pelvic abscess through the culdesac. Drainage had continued for three weeks. Laparotomy had then been performed elsewhere, and the appendix and both oviducts had been removed. The patient had recovered and had been well until June, 1920, when pain in the left lower abdominal quadrant gradually had developed and a mass had been felt in the left adnexa. The patient again had been operated on elsewhere but she did not know what had been done. She had never regained her strength after the last operation; she had had almost constant abdominal pain and a daily temperature of between 100.5° to 102.5°F. On examination at the clinic March 1, 1921, a persistent sinus was found in the old abdominal scar and a tender mass filled the pelvis. Smears taken from the draining sinus were positive for actinomycosis. The patient was given potassium iodide, and treatments with roentgen rays and radium, and reported in 1924 that she was in good health.

Case II. (Mentioned by Sanford) A woman, aged thirty-four years, in April, 1919, had had pain which had developed gradually in the right lower quadrant of the abdomen, she also had had backache and had noted slight fever occasionally. Bilateral salpingectomy, right oophorectomy, and appendectomy had been performed elsewhere in July, 1919, for an "abscess." The region of the wound in which the drains had been situated never had healed and a yellowish discharge had persisted. In November, 1920, the patient had noted a tender, firm mass in the left lower part of the abdominal wall; this had been incised by the physician at her home, and a considerable amount of pus had been obtained. This region also had failed to heal. On examination at the clinic, April 5, 1921, draining sinuses were found at the lower end of the old abdominal scar and near the left anterior superior spine

Fig. 1. (Case III). Colonies of actinomyces invading ovary. (× 100).

of the ilium. A tender, hard, fixed mass filling the pelvis also was noted. Smears taken from the discharge of the sinuses were positive for actinomycosis. The patient was given potassium iodide, and treatments with roentgen rays and radium, but she died October 25, 1921.

Case III. A woman, aged forty-four years, had been well until October 21, 1932, when she had begun to notice backache, mild lower abdominal pain, and occasional high fever. Constant pressure type of pelvic and abdominal pain had continued, accompanied by marked exhaustion. The patient's last menstrual period had been December 5, 1932, and the period before that November 10, 1932. Her menses had not affected the pain. On examination at the clinic February 23, 1932, tenderness was noted in the right lower quadrant of the abdomen. The uterus was enlarged to grade 2, and a hard mass almost filled the pelvis. January 6, 1933, the pelvic abscess was approached through an extraperitoneal abdominal incision

and was drained. The wound continued to drain and, February 9, 1933, the abscess again was entered by an incision in the vagina to the

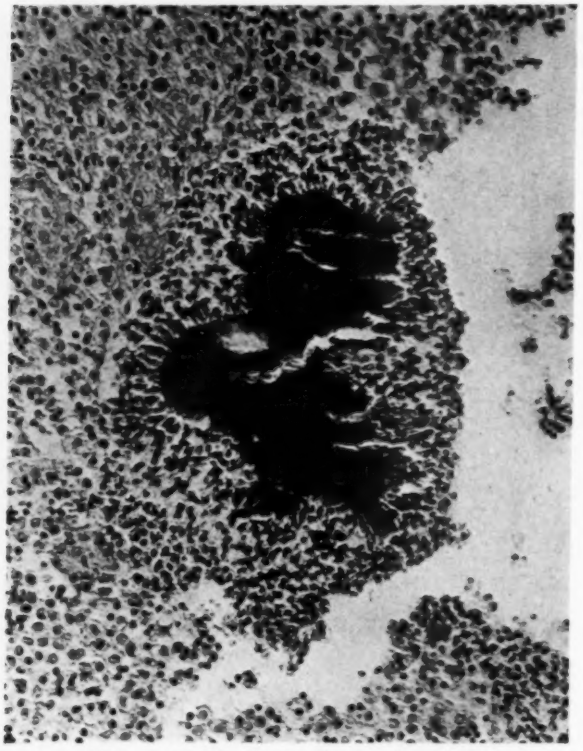


Fig. 2. (Case iv). Typical colony of actinomyces in ovary (sulphur granule). The somewhat granular central mass, which takes the basic stain, possesses club-like filaments radiating from its borders and is surrounded by a zone of lymphocytes, endothelial cells, and an occasional giant cell. (× 190).

left of the cervix. Through-and-through drainage was established with the abdominal wound. The tissue removed from the pelvis revealed necrotic, degenerative changes and contained clumps of actinomycotic colonies (Fig. 1). The patient was given potassium iodide, and treatments with roentgen rays. There was only a slight discharge from the abdominal wound, and the patient felt much better on dismissal, April 10, 1933. However, the improvement was only temporary, and she died July 10, 1933.

Case iv. A woman, aged forty-four years, had been losing weight and complaining of a dragging pain in the left lumbar and coxal regions since October, 1932. A diagnosis of left ovarian cyst had been made, but on exploration elsewhere in April, 1933, a "tumor" between the left ovary and the uterus had been found; it had been thought to be malignant. No tissue had been removed. The character of the pain in the left lower part of the abdomen had not changed following the operation, but had persisted as a dull, dragging ache; the patient had continued to lose weight. On examination at the clinic, October 10, 1933, a fluctuant, tender, cold swelling, measuring about 12 by 10 cm., was noted above the crest of the ilium, as well as a large mass in the left adnexa. On pelvic exploration, October 19, 1933, several loops of small bowel and the sigmoid were densely adherent to a left tubo-ovarian mass. Left salpingo-oophorectomy was performed. The right oviduct and ovary and the uterus grossly were normal. The swelling over the crest of the left ilium was incised October 25, 1933, and both wounds drained profusely. Evidence of partial intestinal obstruction developed. Continuous suction was applied to the stomach and to the wound. The patient gradually failed and died November 7, 1933.

On opening the peritoneal cavity at necropsy, the omentum was bound down and matted together with coils of intestine. Twenty-four centimeters of the lower portion of the ileum was free, twisted on itself, and looped under adhesions between the mesentery and anterior abdominal wall, thus forming a partial obstruction. The stomach contained recent, acute ulcers in the fundic portion. The small and large intestine were covered externally with a diffuse pseudomembrane. The vagina was normal and the cervix eroded, graded 1. The uterus contained some superficial necrosis at the left corner. The right oviduct and ovary were bound down by many recent adhesions. The left oviduct and ovary had been incompletely removed. Microscopically, the uterus was intensely congested and covered with a fibrinous exudate on its peritoneal surface. The right oviduct was congested, and almost complete loss of its mucous membrane was noted. The right ovary was covered with a recent partially organized, fibrinous exudate. A small portion of the left ovary which remained adherent to the broad ligament had lost all semblance of normal structure and was buried in a mass of semi-necrotic tissue. In the depths of this mass were collections of polymorphonuclear leucocytes and sulphur bodies of actinomycosis (Fig. 2).

COMMENT

The clinical course of the disease is of little aid in the diagnosis. The insidious

onset, moderate temperature and pain, unless complicated by a mixed infection, a mass in the pelvis, and progressive debility of the patient suggest the possibility of inflammatory pelvic disease, tuberculosis or malignancy. Not infrequently, on exploration, the disease is not recognized, for the structure of the process may lead the surgeon to believe that he is dealing with a malignant condition, as in Case IV. In addition to the confusion caused by the matting together of the viscera, sulphur bodies may not be discernible grossly, thus necessitating repeated microscopic examination of the pus before the diagnosis is definitely established. The existence of persistent sinuses following pelvic operations elsewhere in 2 cases of this series made it essential to eliminate actinomycosis, but in the other 2 cases the diagnosis was determined microscopically subsequent to operation.

In the first 3 cases reported, the peritoneal cavity was not opened at The Mayo Clinic, so the primary site of the abdominal infection could not be determined. However, there was a definite, left actinomycotic tubo-ovarian abscess in the fourth case at the time of operation, which was confirmed at necropsy. But even in this instance the sigmoid was so intimately involved in the pelvic mass that a primary intestinal lesion could not entirely be eliminated.

Although extension by continuity is not the only method by which this disease develops, for undoubtedly metastasis by the blood stream occasionally occurs, it is the greatest single factor in the spread of the infection. Thus, complete excision of the lesion, or drainage where the former is not practicable, should always be done. Repeated operations, supplemented by massive doses of potassium iodide, treatments with roentgen rays and radium, and general hygienic measures, occasionally effect cure, as in Case I. Consequently, actinomycosis of the female genital organs should not be considered as a hopeless condition, although our present methods of treatment leave much to be desired.

SUMMARY AND CONCLUSIONS

1. Actinomycosis of the female genital organs may still be classified as a rare disease, for only 13 proved cases have been reported from the United States.

2. Four cases of this disease, 2 of which were mentioned previously, have been encountered at The Mayo Clinic.

3. The diagnosis is sometimes difficult to make and the disease is often confused with pelvic inflammatory disease, tuberculosis and malignancy.

4. The condition is not hopeless, but our present methods of treatment are unsatisfactory in many instances.

REFERENCES

1. Ahltorp, G. Ein Fall von Aktinomykose in den Beckenorganen einer Frau. *Acta. Obst. et Gynec. Scandinav.*, 13: 81–92, 1933.
2. Draper, J. W., and Studdiford, W. E., Jr. Actinomycosis of tubes and ovaries. *Am. Jour. Obst. & Gynec.*, 11: 603–608 (May) 1926.
3. Haselhorst, G. Aktinomykose der weiblichen Genitalorgane als Abtreibungsfalge. *Arch. f. Gynak.*, 134: 561–577, 1928.
4. Helwig, F. C. Actinomycosis of the ovary and tube. *Surg. Gynec. Obst.*, 40: 502–509 (April) 1925.
5. Mitra, S. Über Aktinomykose der weiblichen Geschlectsorgane besonders der Partio uteri. *Ztschr. f. Geburtsh. u. Gynäk.*, 88: 249–261, 1924.
6. Poncet, A. and Bérard, L. Traité clinique de l'actinomycose humaine, pseudoactinomycoses et botryomycoses. Paris, Masson, 1898, 410 pp.
7. Robinson, M. R. Actinomycosis of both ovaries and fallopian tubes. *Surg. Gynec. Obst.*, 29: 569–574 (Dec.) 1919.
8. Sanford, A. H., and Voelker, M. Actinomycosis in the United States. *Arch. Surg.*, 11: 809–841 (Dec.) 1925.
9. Sanford, A. H. Distribution of actinomycosis in the United States. *J. A. M. A.*, 81: 655–658 (Aug. 25) 1923.
10. Stein, A. Actinomycosis of the ovary and fallopian tube. *Med. J. & Rec.*, 128: 401–406 (Oct.) 1928.
11. Tietze, K. Sieben Fälle schwerster Schädigung durch Intra-uterinepessare (ein Fall von isolieter Genitalaktinomykose). *Deutsch. med. Wchnschr.*, 2: 1307–1309 (Aug.) 1930.
12. Wagner and Hüffer. Quoted by Brickner, W. M. Pelvic actinomycosis: A study of five consecutive cases successfully treated by operation. *Ann. Surg.*, 81: 343–367 (Jan.) 1925.

POSTPARTUM SEPTICEMIA

DUE TO STAPHYLOCOCCUS AUREUS HEMOLYTICUS WITH REPORT OF A CASE

SAMUEL L. SIEGLER, M.D.

BROOKLYN, N. Y.

PUERPERAL septicemia due to the Staphylococcus aureus hemolyticus is relatively rare. The purpose of this paper is: (1) to report the salient features of a case of puerperal septicemia due to Staphylococcus aureus hemolyticus, complicated by a bilateral hemothorax and multiple lung abscesses and which finally resulted in recovery; (2) to show the relationship, in this case, of serial Schilling indexes to transfusions and complications. (3) to give a resume of the prognosis and treatment of this condition, with a review of the literature of reported cases of puerperal septicemia due to Staphylococcus aureus hemolyticus.

CASE REPORT

Mrs. E. W., was admitted to my service at the Brooklyn Womens Hospital, on May 26, 1932, at 8.30 P.M. Family history negative. She had had diphtheria at the age of five years, otherwise past medical and surgical histories were negative. Catamenia began at the age of fourteen years, was of the twenty-eighth day type, duration was from three to five days, with no dysmenorrhea. Married two and one half years. Last menstrual period August 9, 1931. Date of expectancy as of May 16, 1932.

Her prenatal visits, which began at four and one-half months of gestation, were carried out by her quite religiously. Heart and lungs were negative. There was slight enlargement of the thyroid. Mensuration was normal. Average blood pressure was 140/80. There was always a trace of albumin with no casts, giving one the impression of a low reserve kidney (Stander). Net gain in weight was 21 plus pounds and height was 61¼ inches.

On May 21, fetal heart was in L.L.Q., posterially, cephalic presentation, possible R.O.P. Fetal parts anteriorly. Labor began at home on May 26, 1932, at 10 A.M. She was admitted to the Hospital at 8.30 P.M., at which time she was having moderate, regular, rhythmic contractions occurring every ten minutes. Blood pressure was 140/80. Temperature 98.6°F. Pulse 84. Respiration 20.

Abdominal Examination: Ovoid and longitudinal, striae present, ballotment present, with breech and small parts easily discernible in anterior position. Fetal heart was 140 in R.L.Q. Above the inlet and to the left was felt the occiput and was separated from the back by a deep sulcus. The other side of the inlet was empty. Membranes not ruptured. No engagement of presenting part could be made out at this time by rectal examination, the cervix being, however, 3 cm. dilated with a bloody show.

At 9.05 the following morning, vaginal examination found the position of the fetus in R.M.P., with the chin pointing towards the hollow of the sacrum and a marked promontory. The cervix was 3 cm. dilated.

This being a very formidable position for the presentation of the fetus, the family was so advised. A cesarean section was recommended to them as the safest method for the termination of this labor, so that one could effect the delivery of a living child with the least morbidity to the mother. The patient's husband, however, was adverse to any surgical intervention.

She was fully dilated at 1 A.M., on May 29, fifty-two hours after admission. Examination at this time: fetal heart 140 in R.L.Q., of fair quality. The blood pressure was 144/90. Temperature 99°F. Pulse 82. Respiration 22. Membranes had ruptured the previous day at 9.30 P.M. The patient had received four ¼ gr. doses of morphine sulphate and 5 doses of magnesium sulphate 20 per cent intramuscularly. High carbohydrate diet and fruit juices.

Delivery: An attempt was made to displace the chin, rotate to an occiput anterior position

and deliver the fetus by Dewee's forceps in this position.

After several tractions this was unsuccessful and delivery was effected by version and extraction of a stillborn male child. Bilateral episiotomy was repaired in the usual manner. The placenta was expressed and delivered in the Duncan manner. Estimated amount of bleeding was about 300 c.c.

The condition of the patient on leaving the operating room was fair. Temperature 98.6°F. Pulse 120. Respiration 24.

Her subsequent postpartum course was quite stormy. To relate in detail the daily phenomena as they occurred, would occupy too much space and time. I will endeavour to give, however, some of the more essential data of her subjective and objective symptoms and signs, so that one can visualize the severity of this infection, as it occurred in this case.

Her temperature rose from 101.5°F., on the third day, to 105°F., on the sixth day, when she experienced a severe chill lasting five minutes. This was repeated the following day.

The patient complained of no pain, and her general appearance, with the exception of the anemia, was good. Tongue was moist, heart and lungs negative, abdomen soft, no spasticity or rigidity, uterus soft and not tender.

Vaginal examination showed a purulent discharge from vagina; suture line not holding; cervix lacerated on left; fornices negative; no masses in culdesac; no vesicovaginal or rectovaginal fistulae; no incontinence.

My impression, at this time, was that in all probability I was dealing with: (1) a thrombophlebitis of pelvic veins; (2) general septicemia.

After the second week of her illness, the temperature which had been remitting every other day for twenty-four hours to normal, simulating the temperature curve of malarial fever, began to show the characteristic spike fence type of temperature of septicemia, with elevations to 106°F., and remissions to normal, occasionally twice in twenty-four hours, with severe chills lasting from twenty to fifty minutes, with the accompaniment of rise in pulse and respirations, cyanosis, tremors, etc.

It is of interest to note in passing, that her tongue was always moist, pulse always of good quality. There was a general sense of euphoria, no distention or abdominal pain or tenderness, until the onset of her pleuritic and pulmonic involvement.

On the twelfth day of her illness she was removed out of doors, where she remained until the day of discharge on August 22, 1932, eighty-nine days after admission.

Complications: On June 13, the patient complained of dysuria with a sudden lancinating pain in the right lumbar region. Examination at this time showed a definite right lumbar spasticity, heart and lungs were negative. Abdomen soft, no rigidity or tenderness.There was slight distention.

Since there was no respiratory embarrassment, no cough or hemoptysis, and definite localization of pain with spasticity of lumbar muscles, I considered the probability of a kidney infarct as the cause of the pain.

Cystoscopy: There was evidence of a chronic trigonitis; left ureteral orifice adematous. Both ureters were catheterized to the pelvis; no evidence of any obstruction, no pressure. The right urine was hazy and this catheter was left in situ.

Microscopic examination of bladder urine showed W.B.C., with many clumps; faint trace of albumin; no R.B.C.; no sugar; no acetone. Culture of urine of bladder was positive for colon bacillus. Ureteral urine—right, some R.B.C. and W.B.C. Left negative.

X-ray report, on this date, was as follows: The genitourinary tract was obscured by gas. No curvature of the spine was noted. The liver appeared to be enlarged. No definite pleural or mediastinal changes suggesting active disease were found. The right diaphragm was slightly elevated.

The rise in temperature and increase of nuclear shift to the left on this date prognosticated some complication.

On July 3, 1932, the patient complained of a severe pain on inspiration, on the right side of the chest wall posteriorly, accompanied by cough, with no expectoration. She was dyspneic, color good, pulse good quality and volume.

Examination of chest: No displacement of heart, no adventitious sounds heard. Dullness almost to flatness, on the right side posteriorly, with many moist râles on inspiration, at both bases. Liver to the crest of the ileum. Spleen palpable. Temperature 103°F. Respiration 36. Pulse 120.

From the history of sudden onset, diagnosis of pulmonary infarct was considered, with possibly pneumonitis and pleural involvement.

X-ray report on this date was as follows: Chest: there is a diminished aeration throughout both pulmonic fields, especially on the right side with a proliferative infiltration suggesting a bronchopneumonia.

Here you will also note the nuclear shift to the left with increased leucocytosis.

From July 12 to July 19, her condition was quite critical. Respirations ranged from 40 to 80 per minute, pulse from 120 to 154. At intervals she was very cyanotic, necessitating the administration of CO_2 and O, and intravenous stimulants.

Her chest, at this time, showed a bilateral pleural effusion with an underlying pneumonitis. This was confirmed by a portable *x*-ray examination taken on July 13. To relieve her respiratory embarrassment a paracentesis of the right side was done on July 13, at which time 200 c.c. of pure blood were obtained, which was cultured and reported positive for Staphylococcus aureus hemolyticus.

On July 20 this was repeated on the opposite side with the removal of 400 c.c. of pure blood which cultured the same.

On August 3 she was suddenly seized with a violent spasm of coughing. Her temperature rose to 105°F., pulse 160 and respiration 32. She appeared desperately ill. At this time she expectorated about 8 ounces of foul-smelling purulent sputum, evidently the breaking through of an abscess of the lung to a branch bronchus. The pus collected was cultured and found to be positive for Staphylococcus aureus hemolyticus.

Portable *x*-ray examination, at this time, showed considerable right lower root branch thickening and dilatation. There was, however, a recession of the right pleural level. There was evidence of multiple abscesses of the left lower lobe with small fluid levels. There was also moderate pleuritic thickening on the left side.

Expectant medical and postural treatment was followed for the next few weeks, and, as shown by the chart, there was a gradual subsidence of temperature by lysis until the day of discharge, when the following was noted: No purulent expectoration; a few fine râles (moist) over both bases posteriorly and some dullness on the right side posteriorly. Heart in normal position. Abdomen soft, liver not enlarged, spleen not palpable. Vaginally: no discharge. Lacerated perineum. Normal sphincter action. Cervix lacerated on right, uterus normal in size, shape, contour and mobility. Adnexa not palpable; fornices not tender. Blood pressure 110/80.

On January 5, 1933, almost five months after her discharge from the hospital, examination of the chest was completely negative.

TREATMENT

Williams states that in the treatment of postpartum infection, the best results are obtained by a combination of the greatest conservatism with reasoned radicalism, and that the former is usually, and the latter rarely indicated.

Personally I think this statement should be made axiomatic. Every case of postpartum infection is a case unto itself and one cannot dogmatically say that any one treatment may be empirically applicable to any case. Still, one grasps at any remedy suggested when treating these desperately sick patients.

However, disregarding those of obviously little potency, the procedures of chief popularity in the present-day literature, as outlined by Lowenstein, are as follows:

(1) Supportive measures, such as blood transfusions, infusions of glucose, saline injections, chemotherapy, ultraviolet ray, fresh air, etc.

(2) Surgical measures, designed to remove or drain the original forms of infection and evacuate metastatic abscess, ligations of pelvic veins, hysterectomy, etc.

(3) Administration of substances designed to directly combat the infection, such as mercurochrome, metaphen, gentian violet, transfusions of immunized blood, staphylococcus vaccine, mixed antitoxins, bacteriophages, non-specific forming proteins.

In this case I resorted to small repeated transfusions of whole blood, the patient receiving nine in number. Two transfusions of immunized blood were given (her brother being immunized against the specific organisms isolated from a blood culture). She received hypodermic in-

jections, in graduated doses, of Staphylococcus aureus hemolyticus autogenous vaccine, high caloric diet, fresh air and such symptomatic treatment as complications arose.

I did not use any intravenous dyes, as I felt, first, that the infection was a hemolytic one and that their introduction into the blood stream would cause a further hemolysis of the red blood cells, and secondly, I doubt their bactericidal action when diluted in the blood.

G. F. Pendelton discusses O. Schwartz's article on postpartum infection as follows:

> I consider its (dye's) action somewhat the same as our modern conception of arsenic in treating syphilis which is not spirocheticidal in the blood solution, but acts fundamentally upon each individual body cell, stirring up its production of immunizing bodies and thereby increasing the general body reaction against that infection. In other words, increasing the mass action of body resistance. Blood transfusions do the same thing, building up quickly and maintaining body resistance.

COMMENT

1. There were many *blood cultures* taken in this case. Frequently two were taken in one day, especially on those days when chills had occurred. Of these, three were returned positive for Staphylococcus aureus hemolyticus, and these occurred in the fourth week of the disease. It is my opinion that the late stage of the infection at which the cultures were positive, would suggest that the first dissemination of the organism was by the lymphatics, and that from there, they reached the blood stream. This was clearly demonstrated by Watson in his report on septicemia. There his explanation is supported by the findings of his cases that came to autopsy, in all of which there was a direct evidence of lymphatic involvement. Lillie and Stevens comment that the finding of staphylococcus in the blood stream of septicemia patients is rather unusual, not many cases are reported.

2. It is obvious that a much better picture and insight into the *progress of a patient* with an infection will be obtained from a series of observations of Schilling charts of leucocytes, rather than from a single examination of the blood.

In general, a leucocytosis may be regarded as the effective response of the bone marrow to an increased functional demand for leucocytes, such as may arise during an infection. The qualitative and quantitive character of the response, will depend on two factors: (1) the severity of the infection, and (2) the reacting power of the individual.

The latter will depend in part on the inherent quality of the marrow of the individual and in part on the degree to which the marrow has been directly injured and depressed by the infection.

The evaluation of the total white blood cell count on the basis of the types of neutrophiles present is an index of the reaction of the individual to infection.

Schilling, quoted by A. Piney, gives the following as normal figures for the luecocytic blood picture:

Leucocytes: 6000 to 8000 per cubic millimeter.

Neutrophilic granular cells: 67 per cent. These are composed of 63 per cent of polymorphonuclears and 4 per cent of old metamyelocytes (band or stab forms); the young metamyelocytes (young form or juveniles) is absent.

Eosinophiles: 3 per cent; basophiles: 1 per cent; lymphocytes: 23 per cent; monocytes: 6 per cent.

By nuclear shift is meant an increase or decrease in the stabs or band forms and young or juvenile forms, in relation to the mature segmented forms of polymorphonuclears.

A shift to the left is an increase of these cells, while a shift to the right is a decrease to the normal in the serial hemograms.

A slight degree of neutrophilia with distinct nuclear shift and persistence in the circulation of eosinophiles may be a physiological condition. In the later stages

of pregnancy, changes of this type may occur with, of course, no "toxic" alterations in the neutrophiles. A relative reduction in the number of these cells per cubic millimeter of blood is quite common.

Slight or definite leucocytosis with nuclear shift of moderate degree (not intervals; but there could be no doubt as to the existence of an infection.

High leucocytosis with great shift to the left, tending to progress in the same direction, with great decrease or even disappearance of eosinophiles and reduction of lymphocytes, is a grave condition,

TABLE 1
SERIAL SCHILLING HEMOGRAMS

Date	HGB %	RBC in Millions	WBC in Thousands	M	J	ST	SEG	TN %	TL %	TM %	E %	B %	TR	BC	Comp.
5-31-32	48	2.60	13.1	..	..	..	..	78	20	2					
6-7	46	2.66	21.9	..	3	12	79	94	6	..	..	..	1. Before	..	Sept.
6-8	52	2.80	16.3	..	..	6	78	84	12	4	..	..	After		
6-10	56	2.75	17.8	..	1	10	70	81	18	1	..	..	2. Before		
6-11	57	2.90	16.8	..	2	8	76	86	10	3	1	..	After		
6-13	52	2.65	18.7	..	2	12	72	86	12	2	..	..	3. Before	..	K. L.
6-14	52	2.85	17.3	..	1	5	78	84	14	2	..	..	After		
6-16	59	3.00	14.8	..	1	8	76	85	14	1	..	..	4. Before		
6-18	58	3.25	18.5	..	..	6	70	76	20	4	..	..	After		
6-20	50	2.66	17.8	..	1	8	75	84	13	1	1	..	5. Before		
6-22	53	2.78	11.2	..	..	9	75	84	13	2	..	1	After	P	
6-24	51	2.65	14.3	..	3	12	65	80	18	2	..	..	6. Before		
6-25	50	2.75	12.2	..	2	10	68	80	14	6	..	..	After		
6-27	46	2.50	13.0	..	3	14	69	86	12	2	..	..	7. Before	P	
6-28	48	2.63	13.1	..	1	12	68	81	16	2	..	..	After		
6-30	51	2.65	12.4	..	..	6	71	77	18	2	2	1	8. After		
7-2	47	2.92	15.4	..	2	15	72	89	10	1	..	..	9. Before	P	P.I.
7-3	49	3.10	15.4	..	..	12	68	80	16	4	..	..	After		
7-4	47	3.15	12.3	..	..	6	72	78	19	2	..	..	10. Before	I	
7-7	48	3.23	22.4	..	2	14	78	94	5	1	..	..	After		
7-9	50	3.10	18.4	..	2	16	70	88	8	4	..	..	11. Before	I	P.E.
7-11	54	3.35	23.3	..	..	9	79	88	10	1	1	..	After		
7-15	54	3.65	28.8	..	..	5	82	87	11	2					
7-20	53	3.50	22.2	..	..	7	79	86	13	1					
7-26	45	2.17	12.2	..	2	10	72	84	12	4					
8-1	48	3.20	14.3	..	3	6	61	70	26	3	1				
8-3	50	3.31	18.7	..	2	13	53	68	30	2	..	..	.....	..	L.A.
8-7	58	3.65	16.2	..	..	10	60	70	28	1	1				
8-13	63	3.75	12.2	..	..	6	45	51	40	7	2				
8-20	66	4.00	10.6	..	..	4	40	44	52	3	1				
1-5-33	80	4.50	5.0	..	..	2	62	64	28	6	2				

M, Myelocytes
J, Juveniles
ST, Stabs
SEG, Segmenters
Sept, Septicemia
K.L., Kidney Lesion
TN, Total Neutrophils
TL, Total Lymphocytes
TM, Total Monocytes
E, Eosinophils
P.I., Pulmonary Infarct
P.E., Pleural Effusion
B, Basophils
TR, Transfusion
BC, Blood Culture P, positive
Comp, Complications
L.A., Lung Abscess
I, Immunized.

more than 4 per cent of young forms, and 12 per cent of band forms), decrease of eosinophiles and slight diminution of lymphocytes comprise a picture from which no clear prognostic inference can be drawn. It is, however, indicative of the need of further examinations at short intervals; but there could be no doubt as to the existence of an infection.

which may, however, still be recoverable. It is particularly in cases in which the percentage of young forms exceeds that of band forms that the outlook is very grave.

The persistence of a progressive fall in the total number of leucocytes, with an

extreme and increasing shift to the left, total absence of eosinophiles, and a well-marked lymphopenia are characteristics of grave cases. It may be stated as a general rule, that progressive eosinopenia with rising leucocyte count indicates the presence of an infection, which has overpowered the defensive mechanisms.

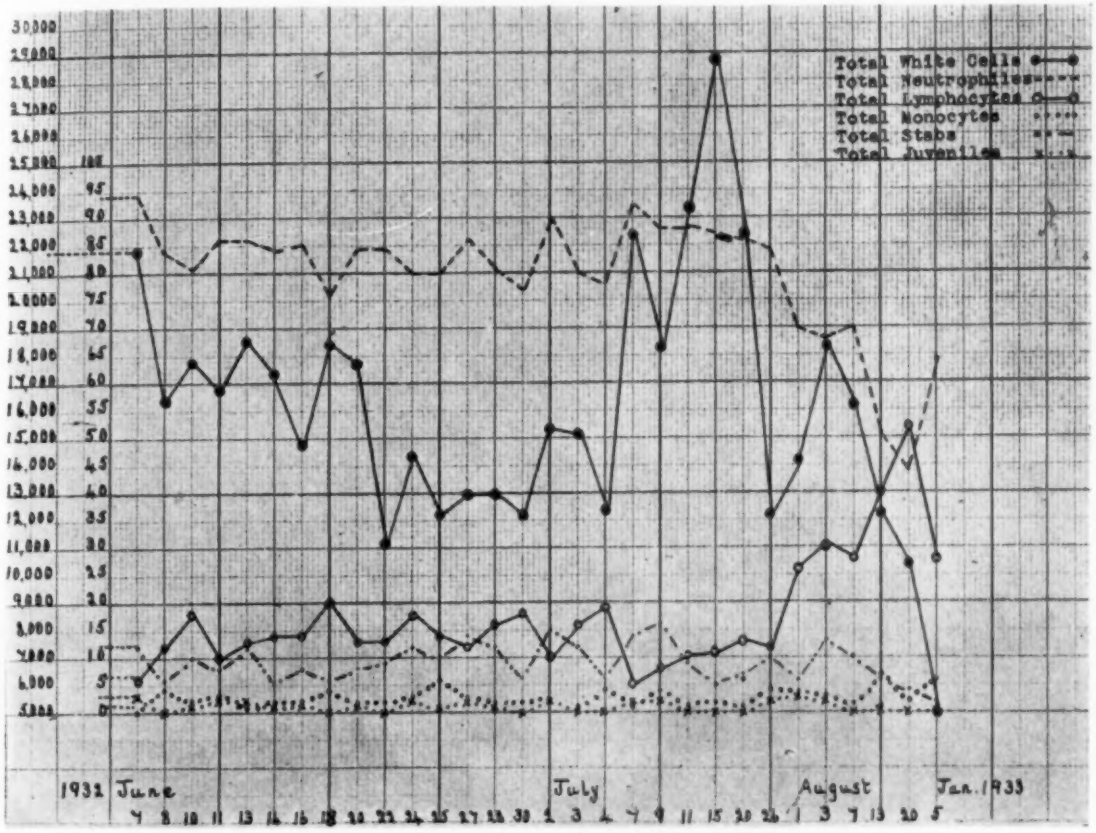


Fig. 1. Composite graph of serial Schilling hemograms.

Reappearance of eosinophiles and fall of neutrophiles in cases in which the former have been absent and the latter excessive is indicative of recovery, and is always accompanied by a progressive movement of the nuclear index towards normal.

The development of lymphocytopenia during the course of persistent infections is always of bad significance.

A sudden fall of the number of lymphocytes in association with progressive neutrophilia always indicates an extension of the inflammatory process; the prognosis is definitely bad in those cases in which lymphocytopenia occurs during a time of progressive decrease of the total leucocytes, and shift of the neutrophiles to the left.

Lymphocytosis following neutrophilia and accompanied by eosinophilia with progressive passage of neutrophiles towards normal, both in number and "index," is indicative of recovery or even convalescence.

From the serial hemograms herein presented, it may be noted that my patient's resistance was fairly good. This, one can conclude, was a moderately severe infection with a good reacting bone marrow (Table 1 and Fig. 1). There was a definite nuclear shift to the left at the development of each complication; and a definite measurable increase in the defense mechanism after each blood transfusion (Fig. 2). One could prognosticate her recovery from her serial blood pictures taken in the last two weeks of her illness, when there was an increase of lymphocytes, presence of eosinophiles,

and neutrophiles and nuclear shift approaching normal limits (Table 1 and Fig. 3).

point and feels, in addition, that changes in the hemogram may antedate clinical symptoms.

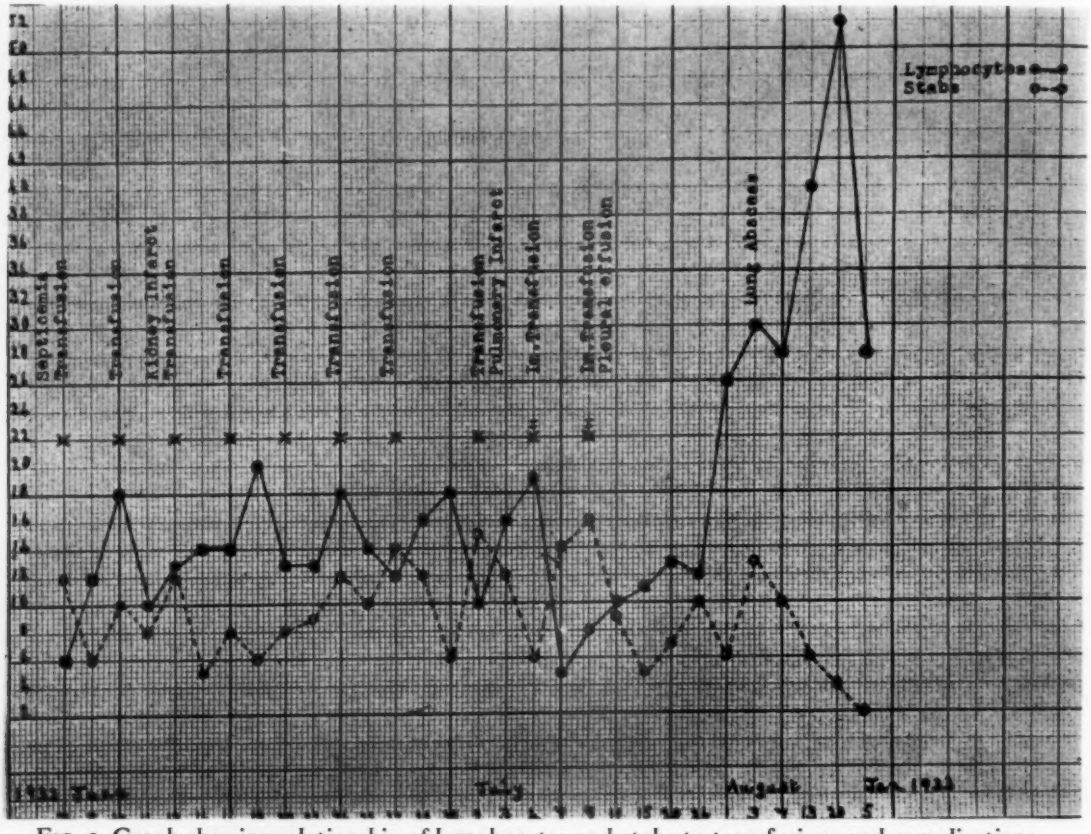


FIG. 2. Graph showing relationship of lymphocytes and stabs to transfusions and complications.

Thus we see that the shift accompanies the whole septic process in a very definite and significant fashion, often effectively supplementing the clinical findings and at times elucidating and surpassing the clinical data.

The blood picture, however, must always be observed together with complete clinical findings. A definite and certain clinical symptom must not be disregarded because of a negative blood picture; nor should marked blood findings be disregarded because of absence of clinical symptoms.

Harter and Lyons quote Baum as taking the hemogram as a true picture of organ pathology and have emphasised the value of repeated counts. He considers it a throughly reliable diagnostic and prognostic aid.

Reznikoff is in accord with this view-

3. The *mortality rate* in staphylococcic septicemia is extremely high, decidedly more so than in cases of streptococcic blood stream infections. Lowenstein's statistics bear out the statement of Stetson, that, contrary to the general belief, the Staphylococcus aureus is the deadliest organism in general septicemia. M. M. Peet, Reed, and Stiles and others have stressed the almost invariably fatal termination of staphylococcus septicemia. Sigwart quotes Baum in saying that staphylococcus is a rare postpartum fever, and that when it does occur, is almost always fatal. Williams and Park report, in a recent book, a series of 230 cases of positive blood cultures; of these the Staphylococcus aureus and albus give the worst prognosis. Seven cases of Staphylococcus aureus had 100 per cent fatality. The albus infections had one recovery

under the age of twelve, whereas there was 100 per cent fatality over twelve. De Lee, Polak, Williams, and Cragin in their respective books on Obstetrics, in discussing puerperal infections, also concur in these findings.

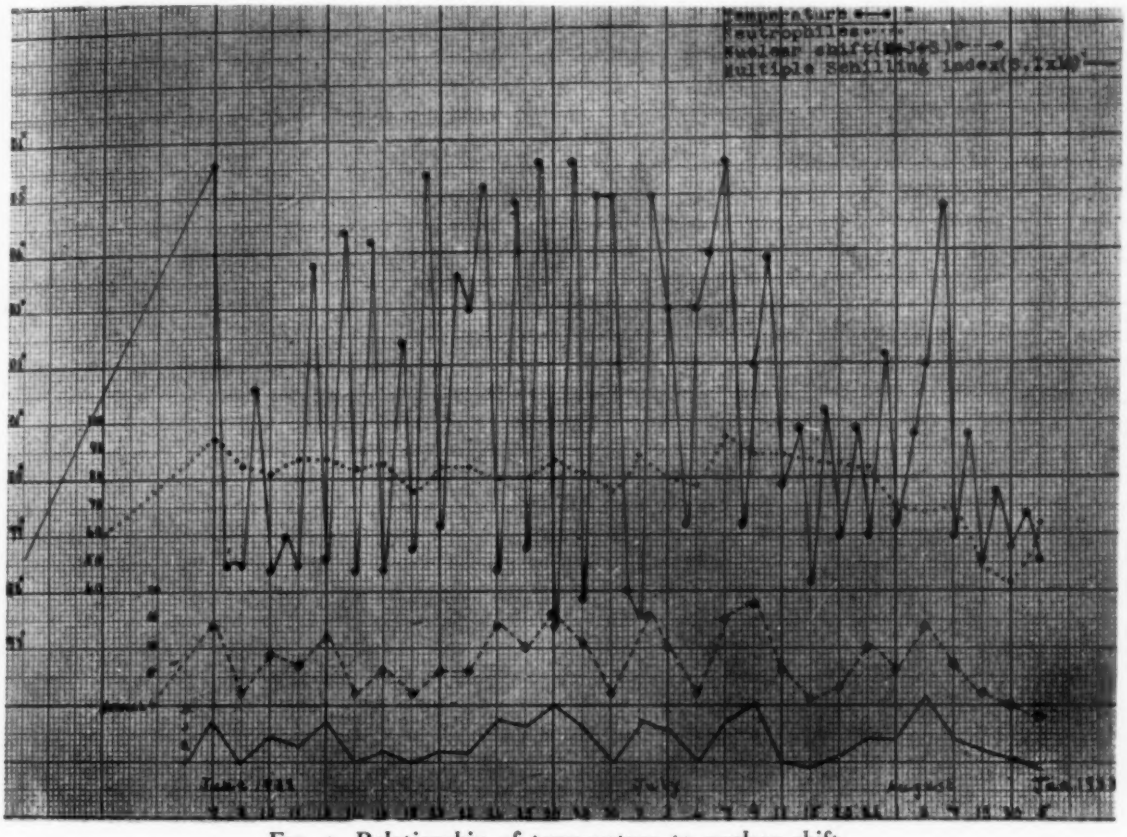


Fig. 3. Relationship of temperature to nuclear shift.

It is of interest to note how few cases of Staphylococcus aureus hemolyticus as a cause of puerperal infection are found in the literature. Polizzotti, in 1910 reported 3 cases of puerperal staphylococcemia, all of which were fatal. Lamers reported a case of puerperal sepsis following abortion due to Staphylococcus aureus hemolyticus in 1911. His patient died twenty-four hours after admission to the hospital. Autopsy findings in his case also showed a hemothorax with multiple lung abscesses. Small abscesses were also found in the kidney as well as the liver. The author made microscopic examination of the pus of the abscesses of the liver, kidney and lungs, and found many staphylococci in pure culture. He summarizes his case by stating that the staphylococcemia originated from the uterus, penetrating the wall of the uterus through the blood and lymph channel, as he obtained pure cultures of Staphylococcus aureus hemolyticus from these organs. The author has never had any success in cases of sepsis with antistreptococcic or antistaphylococcic serum.

He quotes Magnus as knowing of only three such cases, one of Hahn, one of Pawlowsky and one of Strunckmann. Magnus himself published a fourth case observed by him. Hahn's and Strunckmann's patients died. Cases were furthermore published by Thomson and Jaworsky with recovery and by Schwetz, Hoke and Willis and by Spencer. All these patients died. Fromme also reported an infection occurring from this organism, as very rare. He saw 2 cases. Both patients died. In both cases Staphylococcus aureus hem-

olyticus could be recovered in pure culture from the blood.

Lamaire reported a case, in 1911, of postpartum staphylococcic septicemia in a woman thirty-eight years old, eleven days after confinement. This case had localized itself in the left knee, from which he aspirated 700 c.c. of greenish pus which contained Staphylococcus aureus hemolyticus. This patient recovered and the infection was proved by examination of the uterine discharge, the pus from the cutaneous pustules, the blood cultures, the fluid in the knee and finally, the pus from the fixation abscess.

Schottmüller discusses an anaerobic staphylococcus as producing puerperal fever. He concludes that it is not as virulent as that of puerperal infection due to Staphylococcus aureus hemolyticus. It can be differentiated from the thrombophlebitis conditioned by the Staphylococcus aureus hemolyticus and streptococcus, by the tendency of the latter to form lung abscess and the tendency of the anaerobic staphylococcus to spontaneous healing.

In none of these earlier cases was blood transfusion resorted to.

Fitzgibbons and Bigger report 75 cases of postpartum septicemia, two of which were of the staphylococcic type, one of which recovered.

Stetson, in reporting 68 cases of septicemia treated by blood transfusion, reports 2 cases of postpartum infection due to staphylococcus aureus hemolyticus, in both of which the patients died. Halperin reported a case of Staphylococcus aureus hemolyticus, following cesarean section with recovery, in which case he employed blood transfusions of whole blood from immunized donors.

CONCLUSION

1. The result of any infection depends upon two variables; the resistance of the host, and the virulence of the organism.

2. In this case, the staphylococcic nature of the infection was proved by positive cultures of: (a) blood from the blood stream; (b) blood from the hemothorax; (c) pus from the lung abscess.

3. Detailed hemograms help towards prognosticating the severity of the infection.

4. Transfusions were definitely beneficial in this particular infection as shown by the increase in defense mechanism.

5. Recoveries in postpartum septicemia due to Staphylococcus aureus hemolyticus are rare.

I wish to acknowledge my indebtedness to Doctors Max Goldzieher, I. Sherman and Max Danenberg, without whose assistance this report would not have been possible.

REFERENCES

Williams, J. W. Text Book on Obstetrics. N. Y., Appleton, 1930, p. 1053.
Pendelton, G. F. *J. Obst. & Gynec.*, 13: 793, 1927.
Watson, B. P. *J. Obst. & Gynec.*, 16: 157–180, 1928.
Lillie and Stevens. *Arch. Otolarangol.*, 1: 283, 1925.
Harter and Lyons. *Surg. Gynec. Obst.*, 56: 182, 1933.
Lowenstein, R. P. S. *Am. J. M. Sc.*, 181: 196–203 (Feb.) 1931.
Stetson, R. E. *Am. J. M. Sc.*, 168: 532, 1924.
Peet, M. M. Tice Loose Leaf Med., 1921, 5: 421.
Reed and Stiles. *Calif. & West. Med. J.*, pp. 26–492, 1927.
Sigwart, H. In: Halban and Seitz: Biol. und Path. des Weibes. 8: pt. 1, p. 567.
Williams and Park. Streptococcus in Relation to Health and Disease. Balt., Williams & Wilkins, 1932, p. 105.
De Lee, J. B. Principles and Practice of Obstetrics. Ed. 3, Phila., Saunders, 1918, p. 853.
Cragin, E. B. Obstetrics. Phila., Lea & Febiger, 1916, p. 810.
Polak, J. O. Pelvic Infection in Women. N. Y., Appleton, 1924, p. 64.
Polizzotti, S. *Ann. di obstet. Milano*, 32: 283–322, 1910.
Lamers, A. J. M. *Monat. für Gebürts. u. Gynäka.*, 38: 161–167, 1911.
Lamaire, L. *Clinique Par.*, 6: 57–58 (Jan. 27) 1911.
Schottmüller, H. *Centralbl. f. Bakter.*, 64: 270–284, 1912.
Fitzgibbons and Bigger. *J. Obst. & Gynec. Brit. Emp.*, 32: 298, 1925.
Halperin, J. Am. J. Surg., n.s. 16: 637–642, 1932.
Piney, A. Recent Advances in Hematology. Ed. 2, Phila., Blakiston, 1928.

MULTIPLE PRIMARY MALIGNANCIES

PRIMARY CARCINOMA OF THEB REAST IN A MAN WITH PRIMARY CARCINOMA OF THE BLADDER

HERMAN L. KRETSCHMER, M.D. AND NORRIS J. HECKEL, M.D.

CHICAGO

MULTIPLE primary malignancies, although no longer a pathologic curiosity, are still considered a rare clinical entity. This is especially true if multiple carcinomata of the skin are excluded. Up to the beginning of the twentieth century, most of the cases of multiple primary malignancies were reported as individual or isolated cases. Since then a number of group collections have been investigated and studied.

Hansemann in 1000 cancer autopsies found 5 cases, 0.5 per cent, of multiple primary malignancies. In Norway, Gade reviewed 4219 cases of malignancies of which 0.76 per cent were multiple primary tumors. Rau found 17 cases of multiple primary malignancies in 10,393 autopsies, of which 1132 were cancers, or 1.5 per cent. In 36,048 autopsies, Junghanns found 19 cases of multiple primary growths. On the basis of all statistics, according to Warren and Gates, multiple primary malignancies occur in 1.84 per cent of all cancer cases. Several other authors, including Redlick, Brandt and Jekabson, Pearl-Bacon, Muller, Egli, Schabad, Harbitz, Feilchenfeld, and Nicholls have made group studies. Recently Hanlon of the Mayo Clinic collected 18 cases of multiple primary malignancies in 3000 post-mortem examinations. He also reported 31 cases of multiple primary malignancies which were recognized clinically.

Billroth, who in 1860 reported the first case of multiple primary tumors, formulated the following requirements which he considered necessary to make a diagnosis of multiple primary malignancies: (1) each tumor must have an independent histologic appearance; (2) the tumors must arise in different situations, and (3) each tumor must produce its own metastasis. Many authors have objected, especially to the third requirement of Billroth's criteria.

Warren and Gates have advocated the following rules, with which most authors agree: (1) each tumor must present a definite picture of malignancy; (2) each tumor must be distinct; (3) the probability of one metastasizing from the other must be excluded.

There have likewise been different opinions expressed in regard to the classification of these interesting tumors. A simple one, it seems to us, would be to divide them into three groups, viz.: Group 1, three or more malignant tumors; Group 2, double malignancies of the same organ or symmetrical organs, and Group 3, double malignancies of different organs.

It is the third group with which this paper is chiefly concerned, viz., a double primary carcinoma of different organs. The frequency of this group of tumors according to Warren and Gates, who studied 794 cases of multiple primary malignancies, showed that the largest group, or 243 cases, were double primary malignancies of different systems. These were divided as follows:

	Cases
Genitourinary and gastrointestinal tract	61
Breast and genitourinary tract	27
Breast and gastrointestinal tract	27
Skin and gastrointestinal; skin and genitourinary; skin and breast, each	9
Miscellaneous	100

The second largest group of the 794 cases were double malignancies of the same

organ of which there were 149 cases. The third largest group consisted of three or more malignant tumors. There were 111 of these cases. The age and sex were stated in 476 cases. There were 262 female and 214 male subjects. The average age in the male group was 58.3; in the female group 53.2.

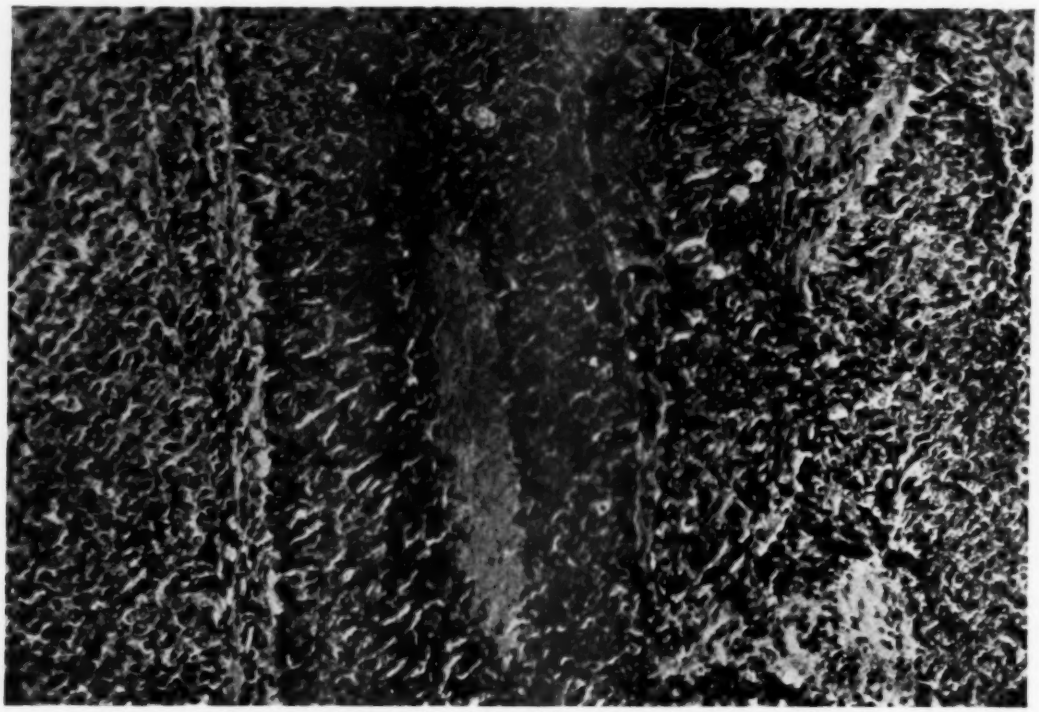


FIG. 1. Papillary carcinoma of bladder with invasion into surrounding tissue.

In a critical review of the cases of multiple primary malignancy, we have been unable to find a single case of a multiple primary carcinoma of the breast and bladder in a male. Because of this fact, the following case is reported.

Careful microscopic studies were made to be certain that each tumor was a distinct and separate primary carcinoma and not a metastasis from the other.

CASE REPORT

Mr. A. J. C., aged sixty-nine, entered the Presbyterian Hospital on August 1, 1928, with complaints of nocturia, frequency, dysuria, hesitation, difficulty in starting the stream and hematuria.

Onset and Course: The patient was perfectly well up to four months ago. He then began to get up two to four times during the night to void. Two months later he had frequency of urination every one to two hours, followed by dysuria and difficulty in starting the stream. Two weeks before admission bloody urine was passed. He has lost 5 pounds of weight in four months.

A lump in the right breast was noticed one year ago. It has grown from the size of a pea to an English walnut. It has not been painful and there has been no discharge.

Past History: Negative, except at the age of thirty-four, he was unable to control both legs and had numbness from the waistline down. This gradually disappeared over a period of one year and has not troubled him since. Fifteen years ago he was catheterized once; the reason he did not know. He had two attacks of gonorrhea, one at the age of twenty-five years and the other at the age of forty-five years. No complications followed.

Family History: Negative for cancer, tuberculosis and nephritis.

Physical examination reveals a man, white, about sixty years of age, not acutely ill. The head, eyes, neck, heart and lungs are normal.

In the right breast slightly above and to the right of the nipple is a tumor the size of a large English walnut. It is firm, but there is a slight

fluctuation on palpation. It seems to infiltrate the surrounding tissue. On the mesial surface the skin is purple and shiny. There is no ulceration. The tumor is not tender. There is no regional adenopathy.

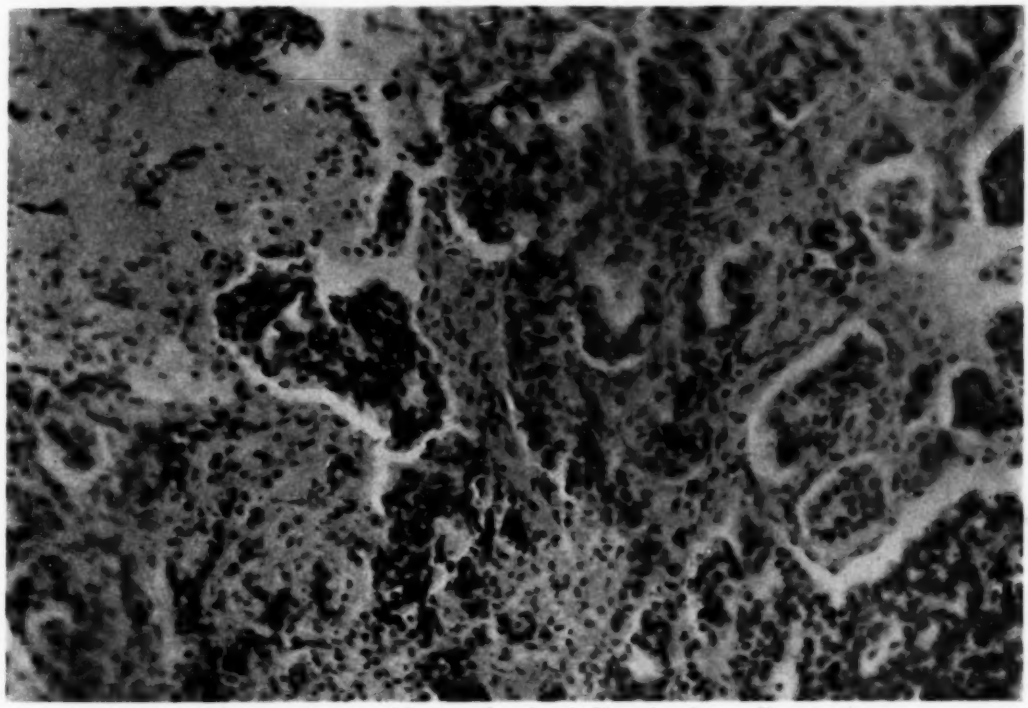


Fig. 2. Adenocarcinoma of breast showing infiltration into adjacent tissue.

The abdomen is negative. There are no palpable tumor masses.

Neurological examination shows exaggerated patellar reflexes; the biceps, triceps, radial and abdominal reflexes are normal.

Rectal Examination: The sphincter tone is good. The prostate is markedly enlarged. It is smooth but extremely hard. At the apex of the left lobe is some thickening and infiltrations running out to the bony pelvis. The left seminal vesicle is thickened.

Genitalia: The penis, scrotum and testicles are normal. There is no inguinal adenopathy.

Laboratory Examinations: Urine: Cultures are sterile. There are 210 leucocytes per cubic millimeter. Albumin 0. Sugar 0. Casts 0. Benzidine test for blood showed 1+. The phthalein test showed an excretion of 68 per cent of the dye in two hours.

Blood count: R.B.C. 4,800,000. W.B.C. 8600. Hb. 90 per cent (Dare). Blood pressure 145/80.

Blood Chemistry: Urea nitrogen 16.0. Uric acid 6.7; creatin 1.7; non-protein nitrogen 34.0 mg. per 100 c.c. of blood. The Wassermann reaction is negative.

Roentgen-ray Examination: Plain films of the genitourinary tract are negative except for considerable lipping of the lumbar spine. There is no evidence of other bone changes and especially from metastasis. The electrocardiogram reveals considerable myocardial damage.

Residual urine: 30 c.c.

Cystoscopy (H. L. K.): There is a marked generalized trabeculation of the bladder. At 12 o'clock is a notch, within which can be seen several nodules up to the size of a hazel nut which look like carcinoma. In the center of the interureteric ligament is seen another similar nodule. The ureteral orifices are normal. No stones or diverticula can be seen.

Operation. Amputation of the breast, August 10, 1928 (Dr. Vernon David): Under ethylene anesthesia the tumor of the right breast was opened and a frozen section made which revealed carcinoma. The usual radical breast amputation was done.

The postoperative course was uneventful. Following the operation the urinary symptoms were much worse and he had several attacks of *complete retention.* The urine was still bloody. The frequency of urination which was every thirty minutes was accompanied by marked dysuria.

Operation (H. L. K.). Suprapubic cystotomy, Nov. 5, 1929: The usual suprapubic midline incision was made and the bladder opened in the usual way. The bladder showed

a moderate hypertrophy; the interureteric ligament was prominent and in the center was seen a small nodule which looked like carcinoma. The internal urethral orifice showed no intravesical hypertrophy of the prostate. Instead it was covered with friable tissue which appeared carcinomatous. The prostatic urethra was hard, fibrous and contained some of this tissue, pieces of which were removed for microscopic examination. One hundred milligrams of radium in needles were inserted about the internal urethral orifice, a suprapubic tube was placed in the bladder and the usual closure made. Twenty-four hundred milligram-hours of radiation were given.

Histological Study of Specimens from Bladder and Breast:

Bladder Tissue: Gross: The specimen is divided into several small pieces; the largest is 1.5 × 1. × 0.3 cm. The tissue is firm and nodular. It is gray yellow with a small amount of adherent blood. The cut surfaces are gray white and nodular. *Microscopic:* The section is made up entirely of large epithelial or epitheloid cells which infiltrate into a heavy connective-tissue stalk. There is a fairly definite arrangement of papillomatous structure. Some bladder transitional epithelium is present. One large area is hemorrhagic and necrotic. *Diagnosis:* Papillary carcinoma of the bladder.

Breast Tissue: Microscopic Examination. In a section of breast tissue about 1 cm. square, there is no noteworthy change in the epidermis, sweat glands or hair follicles. Deep in the section there is a very dense hyalinized fibrous tissue with small, elongated islands of round-cell infiltrations. At the margin of the section opposite to the epidermis are regions of epithelial tissue. In some places the cuboidal epithelium covers small papillae forming spaces altogether about as large as half the low power field. Surrounding such a region there is a marked proliferation of young fibroblasts and slight infiltration of round cell. *In another region* there are small elongated islands of similar epithelium embedded in a dense fibrous tissue. The epithelial cells vary very slightly in shape and density of the chromatin. Most of them have a large nucleolus. A few mitotic figures are observed. *In another section,* 1 cm. or more under the skin there is a dense infiltration of heavy fibrous tissue by multiple irregular islands of epithelial cells that have a tendency to form acini. *Diagnosis:* Adenocarcinoma of the breast.

Subsequent Course: The patient was discharged from the hospital with a suprapubic catheter forty days after the operation. He died three months after leaving the hospital.

A regional autopsy was done which showed an extensive metastasis into and involving the corpus spongiosum, corpora cavernosa, testes and scrotum.

The histology of the metastasis to each of these organs showed a papillary carcinoma.

A clinical diagnosis of carcinoma of the prostate had been made in this case, because of the extreme hardness of the prostate and the fact that the cystoscopic examination revealed only a few small tumors around the internal orifice and only one nodule on the trigone. However, the microscopic examination of these tumors showed a papillary carcinoma of the bladder, and the sections taken from different metastatic areas, viz.; the scrotum and penis showed the same pathological structure.

SUMMARY

1. A case of multiple primary malignancy is reported, a primary adenocarcinoma of the breast and papillary carcinoma of the bladder in a male.

2. Multiple primary malignancies are a rare clinical entity.

3. Attention is called to the unusual metastasis from the carcinoma of bladder, corpus spongiosum and cavernosa and testes.

REFERENCES

Billroth, C. A. T. *Chir. Klin.*, p. 258, 1879.
Brandt, M., and Jekabson, K. *Ztschr. f. Krebsforsch.*, 32: 280, 1930.
Ewing, J. Neoplastic Diseases. Ed. 3, Phila., Saunders, 1928.
Egli, F. *Corr. f. Schweizer Arzte*, 44: 449, 1914.
Gade, F. G. Cited by Harbitz, F. *Beitr. z. path. Anat. u. z. allg. Path.*, 62: 503, 1916.
Hanlon, F. *Am. J. Cancer*, 15: 2001, 1931.
Hansemann. *Ztschr. f. Krebsforsch.*, 1: 183, 1904.
Junghanns, H. *Ztschr. f. Krebsforsch.*, 29: 623, 1929.
Owen, L. *J. A. M. A.*, 76: 1329, 1921.
Puhr, L., *Ztschr. f. Krebsforsch.*, 24: 38, 1927.
Rau, W. *Ztschr. f. Krebsforsch.*, 18: 141, 1922.
Redlick, W. *Ztschr. f. Krebsforsch.*, 5: 261, 1907.
Warren, S., and Gates, O. *Am. J. Cancer*, 16: 1358, 1932.
Muller, R. F. *Ztschr. f. Krebsforsch.*, 31: 339, 1930.
Medwedjew. Cited by Neprjachin, G. G. *Frankfurt. Ztschr. f. Path.*, 34: 562, 1926.
Goriainowa and Schabad. *Ztschr. f. Krebsforsch.*, 33: 594, 1931.
Major, R. H. *Bull. Johns Hopkins Hosp.*, 29: 223, 1918.
Ward, R. *Britisb M. J.*, pt. 2, 511, 1930.

URETHRAL CALCULI*

JAMES F. BALCH, M.D.

INDIANAPOLIS, IND.

ALTHOUGH urethral calculi are by no means a rare finding, the profession as a whole loses sight of this entity and in such moments of forgetfulness may overlook or be confused with such a case. The purpose of this paper is merely to call attention to the fact that this type of calculus disease does occur and to report 2 such cases.

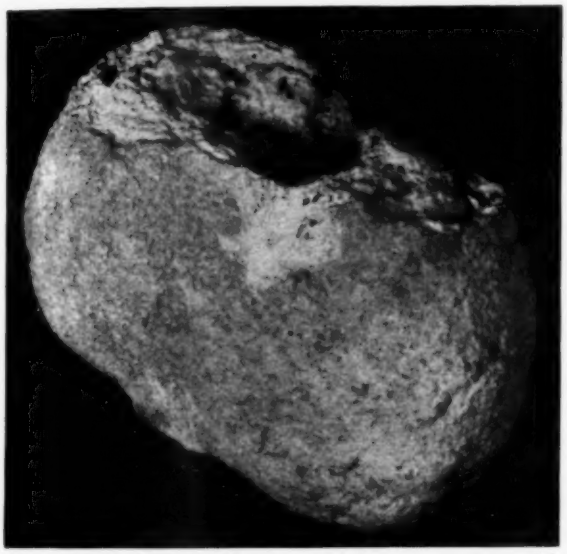


FIG. 1. Phosphatic calculus weighing 40 gm., with "juicy fruit" chewing gum nucleus. Located in posterior urethra. Perineal lithotomy. Reported previously.[3]

Urethral calculi in most instances are urinary calculi, from the bladder or kidney, which have become lodged and arrested in some portion of the urethra. Rarely does the calculus form primarily in the urethra. However such cases do occur, the etiological factor being a foreign body, urethral stricture or an old pouch in the prostatic urethra from which the prostate has been enucleated.

The calculi may be single or multiple, may assume any size or be of any shape. Most of them are elongated and when multiple become faceted due to constant friction.

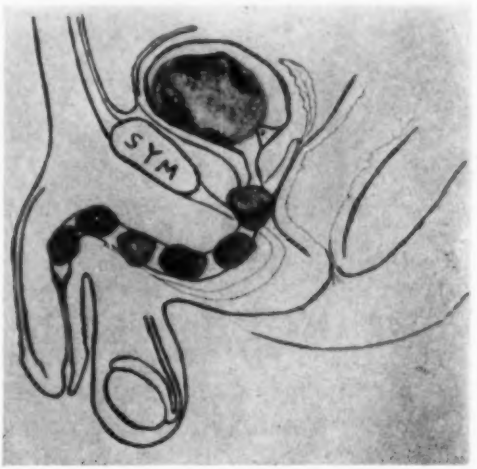


FIG. 2. Bladder calculus and multiple urethral calculi lodged behind a filiform stricture in anterior urethra. Suprapubic lithotomy. Perineal lithotomy. External urethrotomy. (Calculi have been photographed lying on a line drawing to show position in urinary tract.)

They may grow to enormous size. Britneff[1] collected 3 cases from the Russian literature, all the calculi weighing over 400 gm. The largest stone was in Benoit's case, cited by Englisch,[2] which weighed 1050 gm.

The symptoms of urethral calculi differ with respect to the original sight of formation.

If the stone passes from the bladder into the urethra during urination, the onset of symptoms is sudden, with a very sharp and severe penile and perineal pain. Effort on the part of the patient to expel the stone by straining may extrude it from the canal or impact it more securely.

[1] Britneff. Quoted by Keyes, E. L. Urology. N. Y., Appleton, 1929, p. 296.

[2] Englisch. *Zentrabl. f. Harn und Sexualorg.*, 1904.

* Read before the Indianapolis Medical Society.

The largest percentage of impactions occur in children, due to the small calibre of the urethra.

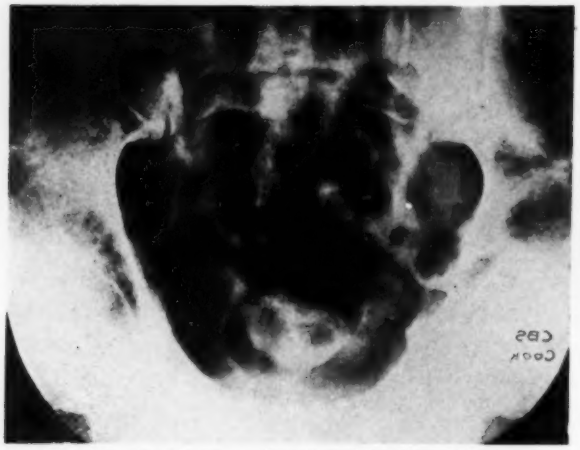


Fig. 3. Radiogram showing bladder calculus.

If impaction occurs acute urinary retention may follow, which of course necessitates immediate treatment. Dysuria, however, is most likely to follow such an impaction rather than acute retention.

Should the stone have formed primarily in the urethra, the onset of symptoms is gradual. The predominating symptom is a chronic urethral discharge which may become quite pronounced as time goes on. Dysuria and a slowing of the urinary stream may and often does occur. If not removed the calculus will produce a periurethritis which may be followed by extensive suppuration, fistula formation and extravasation of urine.

During an acute attack the diagnosis will seldom be mistaken, with the clear-cut history of sudden stoppage of the stream during urination. However, the stone which has formed in situ presents a more perplexing problem. Usually urethral instrumentation will reveal a "grating sensation" on the instrument being used. Palpation will often settle the question. Urethroscopy and cystoscopy in most cases should clinch the diagnosis.

X-ray plates are conclusive with a shadow cast in the midline, whereas prostatic calculi lie to each side of the midline.[3]

[3] Keyes, E. L. Urology. N. Y., Appleton, 1929, p. 296.

Proper management presupposes a knowledge of the condition present and the location of the stone.

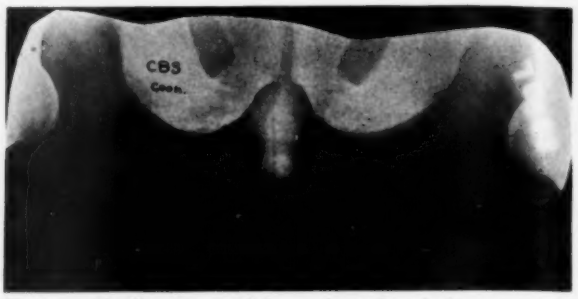


Fig. 4. Radiogram, with patient in sitting position, showing multiple urethral calculi.

Acute cases may be handled in two ways. If the stone is impacted behind the bulbomembranous junction, attempts should be made to push it back into the bladder. In this position it may be either removed with a cystoscopic rongeur or crushed and washed out. If the stone is distal to the bulbomembranous junction the stone should be "milked" toward the meatus and then extracted with forceps, after a meatotomy has been done. Should these methods fail, external urethrotomy is indicated.

Most urethral stones formed in situ are associated with other pathology which makes any hard and fast rule as to treatment utterly impossible. Each case should be managed as the operator sees fit.

Some cases may be adaptable to the afore-mentioned therapy. Others, especially those associated with stricture, most often require external urethrotomy with division of the stricture. Those accompanied by abscess, extravasation and the like, need immediate drainage with removal of the stone. A few cases may be attacked by suprapubic cystostomy with an attempt to divulse the bladder sphincter and thus remove the stone.

The following cases seem to be of sufficient interest to report:

Case 1.[4] C. S., a male, aged thirty, married, came into our office complaining of difficulty in

[4] Garshwiler, W. P., Weyerbacher, A. F., and Balch, J. F. Foreign bodies in the urinary bladder. Am. J. Surg., n.s. 22: 199–202, 1933.

passing his urine. The duration of his symptoms had been about four months and had been steadily growing worse.

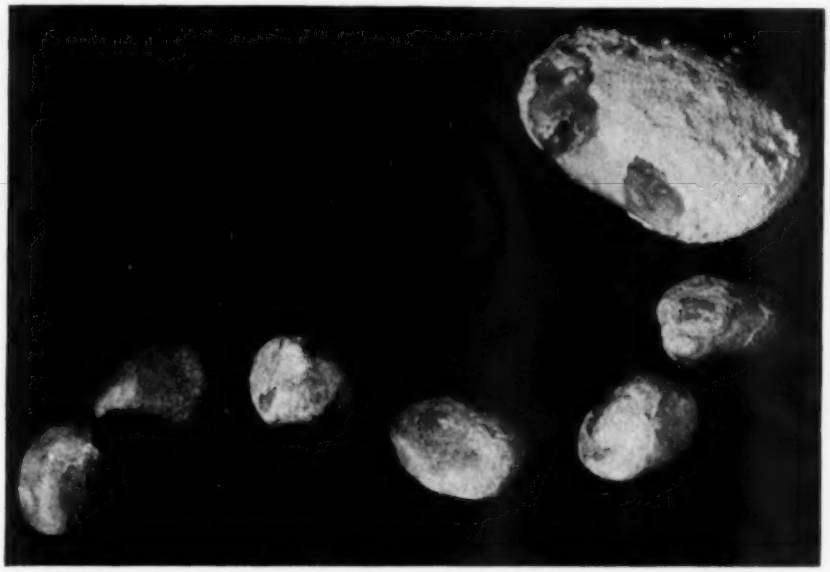


Fig. 5. Photograph of bladder calculus and urethral calculi. Bladder stone weighed 50 gm. and urethral calculi averaged about 2 gm. All the stones were principally composed of phosphates.

After examination, instrumentation and *x*-ray a diagnosis of calculus in the posterior urethra was made.

External urethrotomy was done by Dr. Garshwiler and the calculus removed (Fig. 1). It was composed principally of phosphates and weighed 40 gm. When the stone was opened a chewing gum nucleus was found which was definitely "juicy fruit" in odor. On questioning the patient, he finally admitted having used a chewing gum bougie to "scratch his urethra," some four or five months before. Information was also obtained from his brother that he had practiced masturbation for years.

The patient's postoperative recovery was uneventful until the fourteenth day when he began to lose ground. Eventually a diagnosis of typhoid fever was made and after a stormy sequence of developments encountered in this malady, the patient finally recovered and left the hospital.

Case II. C. J., a male, aged sixty-six, married, entered the hospital complaining of having trouble in passing his urine. He had been bothered for months with a gradual narrowing of his stream to a point of dribbling. Frequency and burning were present in moderate degree.

Examination revealed multiple urethral calculi lined up one behind the other, which could easily be palpated. They were discovered to have formed behind a filiform stricture located in the anterior urethra about an inch and half back of the external urinary meatus (Fig. 2).

Further study by means of a radiogram disclosed the fact that a large bladder calculus was also present (Figs. 3 and 4).

Suprapubic lithotomy was decided upon with the hope that after removal of the large bladder stone, the urethral stones could be pushed into the bladder and also be removed.

The bladder stone was removed with no difficulty but the urethral calculi could not be displaced. External urethrotomy was done and six urethral calculi extracted. The stricture was then divided by another external urethrotomy and a large catheter anchored.

Convalescence was uneventful the patient left the hospital on the twenty-second day with both urethrotomy incisions and the suprapubic wound healed.

The bladder stone weighed 50 gm. and the urethral stones, which were faceted, averaged 2 gm. (Fig. 5). All were composed principally of phosphates.

CONCLUSIONS

1. Urethral calculi are herein discussed and 2 cases related.
2. The etiological factor was a foreign body in one case and a urethral stricture in the other.
3. External urethrotomy was necessary in both cases.

THE PROBLEM OF

DRAINAGE IN PERFORATED PEPTIC ULCER

W. Frank Fowler, M.D., F.A.C.S.

ROCHESTER, N. Y.

TRENDS in surgery are apt to be extreme. At the beginning of the century the skin was prepared with green soap poultices, scrubbed vigorously with a stiff brush on the operating table and inundated with bichloride. Every incomplete abortion was treated by immediate curettement, the pyosalpynx was excised during the acute stage, all linear fractures of the skull were trephined and every potentially infected wound was drained.

Most of the departures from these practices connote progress but the strong trend away from drainage merits thoughtful consideration. In spite of recently acquired knowledge, the omission of drainage spells radical departure from a basic surgical principle. A personal case seems significant.

A man, aged fifty years, suffered a sudden sharp upper abdominal pain. Upon admission the temperature was 100°F., pulse 90, respiration 24. The patient was emaciated and asthenic and looked older than his years. Operation six hours after the onset revealed a perforation 1 cm. in diameter, one inch from the pylorus on the anterior gastric wall, a limited area of plastic peritonitis and a quantity of gastric contents within the peritoneal cavity. The perforation was closed, the fluid in the abdomen sucked out and the abdomen closed without drainage. Recovery was uneventful until the ninth postoperative day when marked distention appeared. The temperature rose to 101°F., pulse 100. An enema afforded some relief. Probing of the wound caused evacuation of considerable green pus. A septic type of fever continued, 99.4°F. at 8 A.M. to 100.4°F. at 4 P.M. until the fifteenth postoperative day.

My first contact with this case was on the thirteenth postoperative day, at which time I came on ward service. After an interval of three days with a temperature of 99°F., the septic type of fever recurred and continued. The patient became exceptionally weak and emaciated. He had marked anorexia. The wound healed fairly well. The abdomen remained slightly distended. There was no abdominal pain and examination revealed no areas of tenderness or masses. The leucocyte count on the twenty-third postoperative day was 9000 with 86 per cent polymorphonuclears. A flat plate of the abdomen was negative for evidence of abscess.

On the twenty-sixth postoperative day the patient seemed in extremis. His leucocyte count was 19,400, 87 per cent polymorphonuclear, hemoglobin 63 per cent, erythrocytes 3,800,000. The evacuations were loose. Examination of the abdomen was negative, except for visible distended loops of bowel in the suprapubic region. There was no abdominal mass or tenderness. Rectal examination revealed a large bulging mass which felt like distended bowel. The diagnosis of pelvic abscess seemed certain.

On the twenty-seventh postoperative day, after a transfusion, the abdomen was opened in the right lower quadrant under local anesthesia. A large pelvic abscess was drained. The pus had colon odor but no culture was taken. Recovery followed a protracted convalescence.

There is much difference of opinion regarding the necessity for and even the advisability of draining the peritoneal cavity in perforated ulcer. McCreery[1] noted in 1924 that drainage was a debated question but apparently the tendency was away from it. In reply to a questionnaire by Guthrie[2] in 1923, 101 of 137 men drained always, five usually. Winslow[2] drained all but one of his 29 cases, one-half of which, however, were over the twelve-hour limit. Stewart and Barber[2] omitted drainage in

only one of their cases. Souther[2] always drained the pelvis.

On the other hand, Bremer[2] considered it necessary only occasionally to drain the abdominal wall, never the peritoneal cavity. Southam[2] used peritoneal drainage only in cases of over eighteen hours' duration and then through a suprapubic stab wound. Paul[2] considered drainage necessary only if there is necrotic tissue or uncontrollable bleeding; Prader[2] believed that drainage was inadvisable in early cases; Gibson[2] felt that it was rarely necessary and then perhaps only in the later cases; Stillman[2] "believed that it is unnecessary if the perforation has been properly closed and the peritoneum cleaned by suction" and McCreery employs it in early cases with steadily diminishing frequency.

More recently the trend away from drainage has increased apace. Stenbuck[3] in 1927 noted that the relation of drainage of the peritoneal cavity to mortality is frequently discussed. On the one hand it is believed that it is impossible to drain the peritoneal cavity by any mechanical means. Stenbuck, however, considers "the claim fallacious that the discontinuance of the so-called drainage of the peritoneal cavity has appreciably decreased the mortality from perforated ulcer. Since the mortality rate varies considerably from year to year no change in the rate should be attributed to the procedure which it follows." On the other hand, the drainage tube is considered a sort of safety vent for possible local accumulation of pus. Stenbuck employed drainage in most of his reported cases in which stomach contents and exudate were lying in the peritoneal cavity. Stenbuck opines that:

> . . . After the source of the peritoneal soiling is eliminated and the proper toilet of the peritoneum is performed it is for the patient to remove whatever soiling remains since little help may be expected from the drainage devices. The quantitative soiling is not the chief factor but rather those factors (poor resistance) which allow the production of a large ulcer may allow also the chemical and bacterial irritants and toxins from the stomach to spread devastation throughout the peritoneal cavity.

Gilmour and Saint[4] in 1932 stated that they did not consider drainage necessary unless there is a large amount of fluid present with much soiling and infection of the viscera when a suprapubic drain is inserted for twenty-four to forty-eight hours. Fisher[5] in 1933 observed that drainage was carried out only when there was obvious gross soiling and inflammation or when the fluid was offensive. Twenty-three of the 38 abdomens were closed without drainage. There were no deaths in the undrained group. Drainage, however, still has its advocates. Shawan[6] in 1933 reported 277 cases of perforated ulcer. One hundred and three of the patients came to operation within six hours and 68 in from seven to twelve hours. Therefore, 171 of the series fell within the early group. Drainage was employed in 203 cases, not used in 15 and not recorded in 9. No macroscopical food debris was seen in those not drained. Most of the drains were of the suprapubic variety.

Regarding bacteriological findings, McCreery reminds us that there is little agreement in early cases of perforation. Deaver[2] reported 23 sterile cultures out of 34 taken. Stewart and Barber stated that the colon bacillus is usually recovered, in one case six hours after the perforation. Bremer in his 15 cases had 11 negative cultures. Prader found negative cultures in 4 of 10 early cases and suggested that sterility might be due to alkaline medium. Gibson implied that early positive cultures are uncommon and quoted Alexander as saying that he had never obtained a growth within the first eighteen hours. McCreery reported cultures taken in 10 of his early cases. In 4 gastric cases, one taken four hours after perforation was sterile, one seven hours after showed Staphylococcus albus, one eight hours after showed hemolytic Staphylococcus albus and one ten

hours after showed Streptococcus viridans. In 6 duodenal perforations, one after three hours showed B. coli communis, one after four hours and one after nine hours were sterile. Therefore half of the 10 perforations of ten hours' duration or less showed growths and half were sterile. Shelley[7] however, states unequivocally that peritonitis is not considered among the complications of perforation as all these cases have a contaminated peritoneum.

Theoretically then, drainage is advisable if not imperative. But we must accept the teachings of Hertzler[8] regarding the peritoneum and its reactions. The introduction of a drain amounts to peritoneal insult. Resentment is shown by prompt walling off of the offending foreign body. Drainage of the general peritoneal cavity, therefore, soon ceases. Yet we cannot ignore the clinical experiment of Williams and Walsh.[9] These investigators report in 1930, 158 cases and state that they always drain the abdomen in perforated ulcer. They quote Bruett to the effect that when the operation was done six to twelve hours after perforation the exudate was sterile in only 26 per cent and over twelve hours in only 7 per cent of the cases. The type of infection and its virulence must always remain an unknown factor. A split tube is passed through a suprapubic wound to the floor of the pelvis and a rigid Fowler position is maintained. The tube is removed in thirty-six hours. Williams and Walsh proved to their own satisfaction that drainage is effective by the following observations:

> In three successive cases of perforated peptic ulcer after the tube had been inserted and just before stitching up the epigastric incision, 2 c.c. of brilliant green was deposited in the peritoneal cavity at the side of the duodenum. The epigastric incision was closed in the usual way. Within a few minutes and before the patient had left the operating table the dye made its appearance through the suprapubic tube. The dressing was changed every four hours and the amount of staining of the gauze and wool noted. The staining was more intense in the first three dressings and steadily diminished in intensity up to twenty-four hours. Between twenty-four and thirty-six hours the staining was only faint. It is evident that for thirty-six hours, at any rate, the peritoneal fluid percolates into the pelvic cavity and is forced through the tube by the positive intraperitoneal pressure.

Such behavior of offending material introduced into the abdomen is consistent with the findings of Hertzler, that foreign bodies are swept toward the nooks and dependent portions of the peritoneal cavity. "This may take place in any direction quite as pronouncedly towards the pelvis as toward the diaphragm."

My experience with drainage has paralleled that of Stenbuck. I have noted in most of my cases little or no fluid. The institution of drainage so far as visible results on the dressings were concerned seemed futile. I have persisted in the use of it, however, not expecting much from it but not daring to dispense with it. To my surprise, then, in a recent case I noted considerable drainage through the suprapubic tube from the pelvis on the third postoperative day, profuse drainage of dirty straw-colored fluid on the fifth day and moderate drainage on the seventh day. Operation four hours after the accident had revealed a duodenal perforation about 3 mm. in diameter and considerable thick grayish fluid all through the abdomen and down into the pelvis. Presumably an accumulation of fluid in the pelvis had been drained away and abscess formation mayhap prevented.

The preferred type of drainage is suprapubic. The pylorus lies approximately at the level of the first lumbar vertebra and even in the supine position fluid escaping from a perforation would tend to flow over the lumbar curve into the basin of the pelvis. The Fowler position, of course, invites gravitation to the pelvis. Drainage of the abdomen by suction when considerable fluid is present is apt to be merely fractional. The holes in the tip of the suc-

tion tube become plugged with the omentum and one usually discards the apparatus in disgust. Absorption of the fluid by the peritoneum, although usually rapid, at first is admittedly subject to wide variations.

Stenbuck classifies the causes of death in perforated ulcer as:

(1) Shock, usually within three days, especially among the elderly,

(2) Generalized purulent peritonitis, usually later, and

(3) Abscess, subphrenic or within the liver. Pelvic abscess is not mentioned.

Fisher, however, states that "sometimes the onset is typically acute but after a certain amount of leakage has occurred, the opening is occluded, the acute symptoms subside and localization occurs. In this way may be formed subphrenic perigastric or pelvic abscess." This simple explanation of the formation of abscess might apply after any perforation.

SUMMARY

A case of perforated duodenal ulcer is reported in which the peritoneal cavity was not drained. Subsequently a pelvic abscess developed. The most likely origin of the abscess was an accumulation of fluid which had gravitated to the pelvis from the site of the perforation. The present trend in the treatment of perforation is away from drainage. It is thought to be futile if not harmful. A case is cited also in which much serous fluid was drained from the pelvis several days after the closure of a perforation. As a result of the leakage from a perforation peritoneal contamination is inevitable. The type of infection and its virulence must always remain an unknown factor. Prolonged drainage of the abdomen is admittedly impossible but clinical experiments with a dye indicate that the peritoneal cavity, contrary to general opinion, can be drained for thirty-six hours through a tube in the pelvis. Therefore, as a means of preventing the occurrence of peritonitis and the formation of pelvic abscess, drainage deserves reconsideration.

REFERENCES

1. McCreery, J. A. Acute perforated ulcer of the stomach and duodenum. *Ann. Surg.*, 79: 91, 1924.
2. Quoted by McCreery.
3. Stenbuck, J. B. Perforated gastric and duodenal ulcers. *Ann. Surg.*, 85: 713, 1927.
4. Gilmour, J., and Saint, J. H. Acute perforated peptic ulcer. *Brit. J. Surg.*, 20: 78, 1932.
5. Fisher, E. M. Perforated peptic ulcer, a review of 38 cases. *Med. J. Australia*, 1: 524, 1933.
6. Shawn, H. K. Perforated gastric and duodenal ulcers. *Ann. Surg.*, 98: 210, 1933.
7. Shelley, H. J. Perforated peptic ulcer. Am. J. Surg., n.s. 15: 277, 1932.
8. Hertzler, A. The Peritoneum. St. Louis, Mosby, 1919.
9. Williams, H., and Walsh, C. H. Treatment of perforated peptic ulcer. *Lancet*, 1: 9, 1930.

NEW INSTRUMENTS

THE KNICKERBOCKER TONGS (OR CALIPERS)

AS APPLIED TO FRACTURES OF THE SHAFT OF THE HUMERUS AND FEMUR A PRELIMINARY REPORT

EDWARD RAYMOND EASTON, M.D.

NEW YORK CITY

THE value of caliper traction in fractures of the long bones has been adequately demonstrated by Besley, Crile and others, but certain defects in the instruments used have detracted from its completely satisfactory performance.

As a result of some discussions with the Director of the Surgical Service of the Knickerbocker Hospital, an attempt was made during the last few months to design a new type of caliper (or tongs) which would avoid the difficulties usually encountered. Finally an instrument was devised which can be used in fractures of both humerus and femur. It is a modification of the Besley caliper, with the addition of several features calculated to extend and facilitate its usefulness.*

By referring to Figure 1, it will be seen that these tongs have a different set of curves from the Besley model now on the market. Its shanks also differ, in that they are terminated by a two-prong fork arrangement that curves inward and the inner surface of the prongs is corrugated to give a larger gripping area without deeply puncturing the bone.

The entire instrument measures 10½ inches in length. The shanks are approximately 2 inches long. The arms of the tongs extend backward from the shanks 3½ inches, whence they begin to curve inward to their point of union at the screw, and backward to the traction loops. The points can be completely approximated or spread to a width of 5½ inches. Near the junction of the two arms is a bar furnished with a lock screw and wing nut, which sets the points of the instrument immovably at any spread that may be desired, thus insuring firm fixation without danger of joggling.

The instrument was recently used on a case of oblique fracture of the humerus at the junction of middle and lower thirds:

The tongs were applied without difficulty through bilateral incisions above the internal and external epicondylar regions. Care was exercised in the insertion, and the tongs were placed above the internal epicondyle so that they did not encroach in any way upon the ulnar nerve. After traction had been applied for twenty-three days, the displacement was markedly corrected and the union firm.

The tongs were removed without the difficulty ordinarily encountered, and the patient's arm placed in a flexed position, with a sling holding it up toward the chin. About one week later massage and elbow movements were begun, and at the present time (eleven weeks after operation) the function of the arm has returned to a considerable extent, the patient still receiving physiotherapy in the dispensary. Wounds healed in ten days after removal of tongs. *X*-ray showed no damage from the instrument at the site of penetration.

After application of the tongs the patient remained practically without pain at any time, either in the fracture or at the points gripped by the instrument. By means of a suspension apparatus (Fig. 3), he was able at almost all times to use his hand, wrist and forearm, and thus maintain their normal function.

* The present design was evolved by the writer through the suggestions of Dr. Ellsworth Eliot, Director of the Surgical Service, Miss Moore, Superintendent, and Mr. Maier, Purchasing Agent. Technical advice was generously given by several instrument makers. We are still working on another model, which will embody more particularly the ideas of Doctor Eliot.

For fractures of the femur, a slight change has been made in design, to allowing complete extension of the leg at the knee

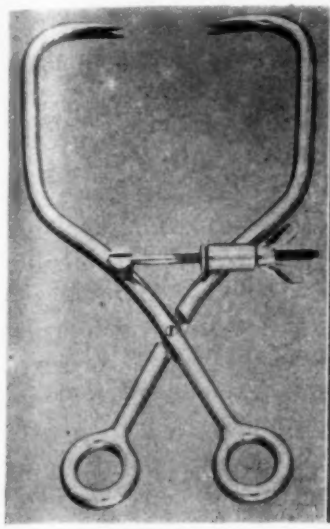


Fig. 1.

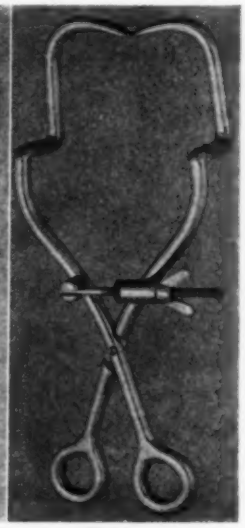


Fig. 2.

during treatment. One of the chief objections to the earlier models was that they prevented straightening of the leg: the instrument, lying in a straight line with the long axis of the femur, would impinge upon the anterior surface of the tibia when an attempt at extension was made. This difficulty was surmounted by Crile, who used adjustable pins which might penetrate the bone to any depth, and to which traction might be applied in any desired direction, while the arms of the caliper, in an upright position, could be used as a suspension. Langworthy described an instrument in which the same principle was involved, although the arms of his apparatus, instead of suspending the leg, passed beneath and hung below the knee. The second design for the Knickerbocker tongs makes both of these maneuvers unnecessary, by the introduction of two right-angled offsets in the arms (Fig. 2). These offsets are 1½ inches in length and are placed at a point 2½ inches from the attachment of the shank. By this means, traction can be obtained at the condyles without the instrument's coming in contact with the tibia, the leg being suspended in a Jones splint with an additional hinge attachment at the knee to allow for flexion and extension of the leg at will through the use of a pulley arrangement as shown in Langworthy's article.

Although this new development has just been perfected and no opportunity has yet occurred to make a practical test, it is the opinion of several other surgeons

Fig. 3.

at the Hospital that it should obviate all the difficulties which have arisen in caliper traction. As far as can be determined by the writer, these are the only tongs in which double prongs and offsets have been used.

The chief advantages are:

1. They do not pierce the bone cortex.
2. There is no tendency to puncture the bone further on traction.
3. They lock so tension on the bone remains the same throughout treatment.
4. By reason of the lock screw they are prevented from slipping.
5. They are easy to remove. The wounds do not become infected.
6. There is no risk of osteomyelitis.
7. The wounds heal kindly within a week to ten days.
8. They are especially designed for the anatomical structure of the part.
9. The instrument can be used for fractures of the femur, humerus or tibia, and is applicable to the bones of a small child or a very large adult.

REFERENCES

Besley, F. A. Value of the caliper in obtaining extension in compound fractures of the femur. *J. A. M. A.*, 70: 87–89 (Jan. 12) 1918.

Crile, D. W. Fracture of the femur on caliper extension. *J. A. M. A.*, 72: 789–794 (March 15) 1919.

Langworthy, M. A new traction frame and caliper for fractured femurs. *Surg. Gynec. Obst.*, p. 125, 1925.

CORRESPONDENCE

To The Editor:

In the August number of THE AMERICAN JOURNAL OF SURGERY in an article entitled "Venoclysis," the undersigned cited a case of Dr. Hendon to show the danger of venoclysis in certain cases. Unfortunately, our interpretation of the events in this case were included in the citation so that it read as follows:

A young boy with abscess of the liver was too critically ill to be operated on and was treated by venoclysis. After several days, the patient had a sudden right heart failure and pulmonary edema due probably to a sudden release of fluid from the liver into the circulation. The Venoclysis was discontinued and the patient made a complete miraculous recovery.

Dr. Hendon's original report was about a child, age four and a half, ill ten weeks. He had jaundice, fever, ascites, an enlarged liver and was too ill to operate upon. Dr. Hendon resorted to venoclysis. After 4,000 c.c. of Ringer's solution had been administered in thirty-six hours the nurse phoned Dr. Hendon that the boy "had suddenly swelled up all over." Dr. Hendon replied to stop the venoclysis immediately and when he saw the boy the next morning he found him in a state of general anasarca. However, from then on the patient improved and remained well one year after discharge from the hospital. Dr. Hendon noted: "I report this case empirically without any hypothesis to explain the results except the theory of dilution of toxins."

Very truly yours,
JOSEPH TOMARKIN.
ABRAHAM STRAUSS.

QUADRENNIAL PRIZE OF THE INTERNATIONAL FOUNDATION OF GYNECOLOGY AND OBSTETRICS

In order to perpetuate the intentions of the Committee having charge of the funds of the past International Congress of Gynecology and Obstetrics, the Administrative Council and the Consulting Committee of the Société Belge de Gynécologie et d'Obstétrique, the actual legal managers of the said funds, have decided to use the revenue of the foundation for a prize of ten thousand Belgian francs, to be awarded every four years.

The prize will be given to the author of the best paper in Gynecology or Obstetrics published during the four years preceding the time of the award.

The papers presented for this prize must be published in the official languages of the International Congress, namely German, English, Spanish, French and Italian, or translated into one of these languages.

Two copies of the paper must be sent to the Secretary of the Société Belge de Gynécologie et d'Obstétrique, twelve months before the fixed date for the award of the prize (Dr. Max Cheval, 16 Alphonse Hottat Street, Brussels, Belgium).

The Committee of Judges charged with the examination of the papers presented will be named by the Society, from its active, corresponding and honorary members, national as well as foreign, and according to methods to be ultimately determined by the Society. The President of the Society will preside. The judges cannot take part in the contest.

The decision of the Committee of Judges will be made according to the majority of the votes. If no paper seems worthy of the prize, this will not be awarded and the amount will be added to the value of the next prize. The prize of the International Foundation of Gynecology and Obstetrics will be given, for the first time, in July, 1938 at the time of the monthly meeting of the Société Belge de Gynécologie et d'Obstétrique.

WILLIAM EDMONDS HORNER

[1793-1853]

WILLIAM EDMONDS HORNER

WILLIAM EDMONDS HORNER was born in Warrentown, Va., June 3, 1793. Although descended from distinguished ancestors, the family had little money but a high premium was placed on education. A frail, physically weak lad, he shrank from the usual games and became a veritable bookworm.

At the age of eleven years he studied under the Rev. Charles O'Niell, a classical scholar. In 1806, Horner began the study of medicine under the preceptorship of John Spence; this he continued for three years. He then entered the University of Pennsylvania (1810). It was his good fortune to sit under Benjamin Rush, Philip Syng Physick, Caspar Wistar, Thomas C. James and Benjamin Smith Barton. His studies were interrupted by the War of 1812, but he received his degree April 8, 1814. He resigned his commission (March, 1815) and went to his home in Warrentown where he opened an office with his brother, a lawyer. However, the life was slow and he chafed under the mental inactivity. Therefore, Horner moved to Philadelphia (December 3, 1815).

In recognition of Horner's ability as a dissector, Caspar Wistar put him in charge of the anatomical specimens used in his course in anatomy. For this Horner received $500 a year. John Syng Dorsey succeeded to the chair on Wistar's death, and he made Horner a demonstrator in anatomy and turned the entire dissecting class over to him. Dorsey died before he actually entered into his professorial duties, and he was succeeded by Philip Syng Physick, who made Horner an adjunct professor of anatomy (November 17, 1819). On the resignation of Physick, Horner was elected to the chair of anatomy in November, 1831.

Horner was Dean of the Medical School at Pennsylvania University for more than thirty years. Under his guidance, this school held to the highest standards in medical education.

Scientifically, Horner is credited with discovering the tensor tarsi (Horner's) muscle supplying the lacrimal apparatus (1824); he investigated the odoriferous axillary glands in the Negro, the muscular tube of the rectum, and the membranes of the larynx. He was a brilliant operator for his time. He published treatises on anatomy (1826) and pathology (1829). In 1824, in the *American Journal of the Medical Sciences*, he published an important paper showing the rice-water discharges in Asiatic cholera to consist of epithelium stripped from the intestine.

A morose, religious, dour man, William Horner was the father of ten children. The death of a daughter in childbirth completely broke his spirit, and after an illness of a few weeks the end came on March 13, 1853.

T. S. W.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

CONCERNING THE HISTORY OF SYPHILIS*

H. SUTHERLAND CAMPBELL, M.D.

LOS ANGELES, CALIF.

ONE cannot fail to admire the conciseness of a certain definition of history stating that it is "the recital of accomplished facts presented with order and in writing." In dealing with the subject matter syphilis, however, one may perhaps be pardoned for distorting it, inasmuch as the history of syphilis will always remain shrouded under the cloaks of ignorance and autocracy in addition to the common cloak of time. In this presentation, therefore, we shall commence with what has been somewhat officially accepted regarding syphilis up to the present day, and shall also consider certain significant data in order to determine whether they add to or detract from the former conclusions.

In the International Encyclopedia one finds the following:

Descriptions of syphilis are found in the earliest writings and in the bones of prehistoric people. Although the malady was known to have existed in Europe as early as 1250 A.D., when Theodoricus, a monk wrote of the Malum Mortum and recommended inunctions of mercury for its cure, its authentic and general recognition dates from a severe outbreak of the disease in the army of Charles the eighth of France, during the seige of Naples in 1493. It was known as the Neapolitan disease and as the Morbus Gallicus.

Osler stated that it was still being discussed as to whether it was known in the eastern world before the return of Columbus from Haiti. He mentions that writers contending for the antiquity of the disease in China and Europe relied upon old Chinese records, biblical references and old medical writings, on diseases resembling syphilis and on suggestive bone lesions found in very old skeletons, concluding that "the balance of evidence according to the best syphilologists is in favor of its American origin." These more or less official opinions are from two authoritative sources and there appears to be some slight disparity between them. Indeed, the early available international data on syphilis disclose but one point upon which all are apparently agreed, namely, that no single civilized nation is admittedly responsible for its being.

The grace with which the old time diplomats of the various nations transferred the onus of it is well demonstrated in a letter written by the German Knight,

* Read in part before the Symposium Society of Los Angeles.

Ulrich von Hutten, to his patron Prince Albert, Cardinal and Archbishop, in the year 1515.

It has seemed best to God that in our age disease should arise unknown, as we may judge, to our ancestors. In the year 1493 or thereabouts there crept in a baneful disease; not first in Gaul to be sure; but at Naples. The name of it however, was taken from the army of the Gauls which was fighting at Naples, under King Charles, from which occurrence the Gauls fending off from themselves the ominous name, call it not the Gallic but the Neapolitan disease and consider it an insult that this pest is named from them. Nevertheless, the concensus of humankind has prevailed, and in this work I shall call it the Gallic disease; not with any degradation to that most glorious peoples than which there is scarcely any more civilized; but in the fear lest all might not sufficiently understand if I called it by any other name.

This man Ulrich was intended for the priesthood but rebelled against it, becoming a social outcast and wanderer. Early acquiring the disease he wrote about it at length, describing the various phases of quackery to which he subjected himself with no small degree of bitterness. He was not trained as a doctor and the above is his introduction to an eulogy on the use of guiacum in the treatment of syphilis, which resulted from a combination of his own experience coupled with gleanings from contemporary gossip and literature. However, in describing the phenomena of syphilis he manifested one fundamental which holds to the present day, and this reflects upon the definite uncertainty of the course of the disease, as witness the following: "Those whom it already has attacked according to their mode of life, it either leaves, holds for a long time, or consumes entirely." The former group probably corresponds to the asymptomatic form of syphilis; the latter to the rapidly advancing type of general paresis of the insane, or possibly to what is very rarely seen today: "malignant syphilis."

Regarding the early history of syphilis: There are two main sources from which to make our deductions: (1) the writings of poems, recitations or letters to or for patrons; (2) treatises on disease. With regard to the former, some appreciation of the conditions under which individuals existed during those times is essential to truly evaluate their work. Primarily, the patron was a man of great power and wealth, usually of the nobility. Secondarily, it appears that he was a very necessary commodity in order that the writer be able to publish any documents for posterity. It naturally follows that whether the patron was a rascal as they sometimes were, or a godly man as occasionally happened, little to nothing was published which did not meet with his approval. We must also remember that even were the patron in sympathy with certain views of the writer, he in his turn was forced to be very circumspect in what he allowed to be published. To appreciate this one has only to read comparatively recent history to realize how little offense in that respect was necessary to warrant the severest of punishment.

Regarding treatises on diseases: While delving into the history of psoriasis some years ago, it became apparent that during the Grecian, Roman, and Arabian eras of medicine, as witness: Aetius, Hippocrates, Galen, Aegiente, Celsus, and Hali Abbis, the term *lepra* was used to designate many things, and from that time through the middle ages, until approximately the eighteenth century it was used to designate practically all diseases which were particularly obstinate, or those in which the skin presented a loathsome appearance. Furthermore, the biblical description of leprosy, "whiter than snow," is much more nearly descriptive of a certain type of present-day psoriasis, which it cannot be denied is widely at variance with the clinical appearance of leprosy.

While this may be attributed to a confusion of terms, it cannot be denied that medical treatises of that period would be somewhat indifferent authority upon

which to base the proof of the antiquity of syphilis. In face of this, it seems incredible that the lack of a more recently acquired name should be taken as proof of the non-existence of any given disease. One strongly suspects that leprosy, psoriasis, syphilis, and at times even simple, exudative eczema of extensive involvement would be classified alike, and cannot help but feel that an examination of any given group of individuals of that period, who were segregated by law and forced to shout "unclean," would afford most medical men of today no small degree of consternation. In this respect, in a short chapter contained in H. Frascator's general medical work "De Contagiosi et Contagiosis Morbus" devoted to elephantiasis (lepra), he stated that in certain hospitals in Italy, which were dedicated entirely to patients suffering from this disease, he found very few true lepers, but many patients affected with other simple cutaneous affections interned by mistake. The immediate value of early terms in medicine might further be estimated from the fact that recently, certain authorities took opposite views of the meaning of the term "gros mal," some believing it referred to syphilis, others that it described epilepsy.

So, while we may glean much from the writings of olden times, I doubt if we can truly evaluate what was written. It is ironical that "Syphilis sive Morbus Gallicus," that masterpiece of the centuries by Fracastorius, should be interpreted by some as tending to imply that this disease originated in the new world; but this is debatable. The poetical expressions are somewhat confusing and sometimes apparently contradictory as witness, in the first book "Is it not possible that the cause rests with those men (Columbus') who, leaving from the Spanish shores tried to explore unknown seas and lands opposite from ours?" and "We are to believe, since time glides on eternally, that it has been seen on earth, not once, but many times before, although not known by name to us." More definite is another stanza: "Moreover, it would be impossible in so short a time for a contagion which is slow in its action and not easily taken to have traversed so much territory if brought for the first time to Spain in one ship." One might with justification wonder if this seeming ambiguity resulted from a struggle between the individual opinion of Frascatorius and the wounding of the very comfortable one which obtained at that time. However, it is generally accepted that this first book condemns the view that syphilis was introduced by Columbus' crew from the Americas. It will be recognized that the name of the disease coined by Fracastorius in 1521, and published in 1530, stamped it as an entity for the first time. But the coining of a name for a disease undoubtedly bears no relationship to its age.

Long deliberation indicates that the circumstances surrounding the subject matter concerning the early spread of syphilis are decidedly opaque and little to be relied upon. The most feasible and possible solution is contained in the main expression of Fracastorius, viz.: that it was an acute exacerbation of a long existing and somewhat attenuate disease. Indeed, with but a single exception, the palpable weakness of the various objections offered this theory constitute its greatest strength. In this respect one gleans a certain amount of satisfaction in attributing one's own meaning to a term so often used by historians who literally insist upon the American origin of syphilis, viz: Epidemic "A season of the extensive prevalance of any particular disease." This, it is true, is in its strictest sense a petitio principii, but there is, nevertheless, some modicum of satisfaction in the acceptance of the translation of its meaning into the sense which one wishes to accept, which one believes represents the truth, and which is accepted as one of its definitions.

Let us consider Fracastor's theory concerning the origin of this disease. We know that he named syphilis and that his theory regarding its cause was correct, and this

at a time when popular beliefs regarding its cause were as strange and as variegated as were their remedies for it. In fact, the greatest of this work does not lie in its prose, which some acclaim, but in that it was correct. One may be forgiven for suspecting that he was equally correct in his theory regarding its origin, which is to be found embellished before with a tactful suggestion and after with supporting denial. Objection to the theory is made on the ground that previous to this time no description of any disease is to be found describing genital lesions followed by generalized eruptions. It has been indicated that at this period of time writings of any dependability were the exception rather than the rule. Therein lay the value of Fracastor's work. Furthermore, it must be remembered that a fairly large number of syphilitics do not demonstrate primary lesions; another group manifests primaries but no secondaries; in still another group only tertiaries are seen. And as Ulrich has so definitely indicated the same individual modifications of the disease existed then as exist today, it is only to be expected that under the circumstances it would be divided into several diseases, which might well explain the disappearance of certain old maladies at this time. No less an authority than Proksch, the Viennese medical historian, affirms that up to 1495, lepra had been one of the worst scourges of the human race; that malum mortum, juis persicus, and fornica had been severe afflictions yet after this time (of the appearance of syphilis) the latter three diseases disappeared entirely, and leprosy became much scarcer. But curiously enough syphilis was on the increase everywhere. It is vastly more logical to suppose that they had been incorrectly diagnosing syphilis rather than that three separate and distinct diseases should vanish off the face of the earth at identically the same time that the new disease, syphilis, made its appearance.

In this respect may we not justifiably emphasize that a mistaken conception of syphilis and gonorrhea being the same disease obtained at a much later date, inasmuch as medicine in general believed that both these diseases were different manifestations of the same disease, and this belief obtained until approximately 1850, when Phillipe Ricord manifested the specificity of syphilis. He also divided it into its well-known three stages for descriptive purposes, because of the multiformity of its manifestations. Significance also may belong to the fact that although the disease, syphilis, was apparently unknown before 1493, they had a remedy (mercury) at hand and used it immediately. It is also in order to recall at this time that during the thirteenth century, Alexander of Tralles recommended cinabar for chronic swellings and wart-like sores on the privates. And Nicholas Myrepsus, a physician of the same period, recommended the rubbing in of mercury ointment for the beginning stage of lepra.

The suddenness of the appearance of syphilis in Europe has been advanced as a measure of proof of its introduction from the Americas. This contention obviously manifests a disinclination to accept historical data concerning the profound influence exerted upon medieval life by a succession of epidemics, all of which were somewhat conspicious by their suddenness. As a later instance, the great plague of London might be cited. One could even fairly contend that it was vastly more sudden than this much earlier epidemic of syphilis. A similar contention could aptly be made regarding the more recent influenza epidemics during and following the world war. Consider the circumstances surrounding the sudden appearance of syphilis. The period of time was marked by possibly the maximum degeneration of the Italian peoples following their conquest of practically the entire known world. The full return of the pendulum had been reached and Italy, trembling on the verge of disintegration due to years of license, corruption and internal strife, was over-run by what

might charitably be called an army, composed of mercenary rabbles gathered from all parts of Europe by Charles VIII of France. This horde passed into and over the somewhat luxurious remains of what had been one of the greatest empires in the history of the world. As was to be expected, the passing over of this army only served to increase the licentiousness which in general obtained. Naples was reached at the end of a machiavellian march in February 1495, but the results of their excesses forced the army to evacuate the city a few weeks later. The picture of the retreat of this disorganized, terrified and diseased rabble, shortly following its so-called glorious achievement, is one of the tragic highlights of history. Thus, it would appear the circumstances and conditions necessary for an exacerbation of an attenuate syphilis were excellent: A congregation of conglomerate peoples; little to no sanitation; unclean living conditions; prostitution, debauchery, and drunkenness; mediocre therapy of the period unavailable. One believes that the same circumstances obtaining, the recent war could readily have produced a somewhat similar form of syphilis.

Now, as to the severity of this disease being offered as a measure of proof of its newness, it must be conceded that even under the most rigorous control war is especially prone to produce epidemic forms of disease of peculiarly virulent manifestation. Indeed, the influenza epidemics during the late world war could be taken as classic examples of increased virulence of epidemic forms of endemic diseases. Primarily in the zones of war, from thence spreading fairly rapidly to the different parts of the world. Of such severity were its manifestations that it was given a qualifying term "Spanish" and not a few of the centers of medicine were in a quandary at the outset as to what they were dealing with. Certain of the suggestions ventured were: (1) that they were dealing with a combination of known organisms acting the more virulently in symbiosis; (2) that they were dealing with a new organism of special virulence. A noted pathologist emphasizing its originality of manifestation stated "many of these cases have actually drowned in their own secretions." As time passed the disease followed the usual cycle in attenuation until it was again universally accepted as influenza. It is ironical that the inception of both these epidemics should be attributed to the Spaniards.

And now to consider, in some small measure, data concerning the Americas: In a common assumption that the entire American continent was long syphilized, it becomes worthy of note that years before Columbus, Leif Erickson visited Vineland, which history maintains must have been the Americas. These Northern peoples were hardy, war-like adventurers. After remaining for a lengthy period of time they returned home. Insofar as possible it has been ascertained there is no mention of any new disease following their return. It is true that most of our information concerning them comes to us in the form of sagas or minstrel songs possessing no great merit, its value, however, might often be shown to be greater than that gleaned from the writings of certain documents of later periods.

While it is extremely difficult to obtain a clear conception of the Indians, who inhabited this continent during these early periods, the consensus of opinion would indicate the earliest general writings concerning them to be the work of the Jesuits. From some of these records the following brief but significant description was taken: "They prepared themselves for defense. They were strong, vigorous men with indomitable wills. Women were regarded very highly; for violation of a woman a man was put to death. Their standards of morality were high; marriage especially being similar to the Christian conception of it." In face of this sober description of a peoples, it becomes difficult to accept a depraved picture of the Indians; and while it may be correctly contended that

the former description applied to possibly only one of very many tribes on this vast continent, it becomes necessary to realize that the latter cannot be universally accepted. In the introduction to "Original Narratives of American History" we find the following: "The contents of Columbus' Journal of his first voyage was first made known to the public in the epitome incorporated in Ferdinand Columbus' 'Life of the Admiral' which has come down to us only in the Italian translation of Alfonso Ulloa." The work that ensues is in the form of a log or diary. On page 110, one finds "what follows is the actual words of the Admiral in his book of the first navigation and discoveries of the Indies." (The original journal.) The words referred to are relative to a description of the Indians with which we are concerned, and which have been synopsized:

> They go as naked as when their mothers bore them.
>
> They are very well made with very handsome bodies and very good countenances.
>
> They are of fair stature and size, with good faces and well made.

And now quoting from the author's description:

> As soon as dawn broke many of these people came to the beach. All youths as I have said, and all of good stature. A very handsome people. Their hair is not curly but loose and coarse like horses hair. In all, the forehead is broad, more so than in any other people I have hitherto seen. Their eyes are very beautiful and not small, and themselves far from black, but the color of the Canarians. Their legs are very straight, all in one line and no belly but very well formed.

It cannot be gainsaid that the above descriptions are somewhat incompatible with those of hereditary syphilis, irrespective of the age of the soil; and from their common practice of swimming out to the ships, coupled to the description of the way in which they righted and bailed out their large canoes following an upset, the belief is in order that one is dealing rather with athletes of the first rank. In this regard it must be emphasized that no questioning attends upon the integrity of the later descriptions of syphilis among the Indians, as more recent history indicates that a depraved picture of primitive peoples regularly obtains in that segment of them which comes in contact with civilized men and we have no logical reason to believe that time has caused any degree of change in this respect.

A consideration of the earliest official record attributing this epidemic of syphilis to the Indians leads one to appreciate that it was the direct outcome of a royal command by King Charles v, which resulted in an excellent article by Ortega, most aptly termed a recitation. It is a matter of no small moment that this task should have been deputized to a Spanish advocate rather than to a physician. This work later found not a few corroborators, some in medicine, as an instance Las Casas' description of the mildness of syphilis as it existed among the Indians is worthy of repetition: "the Indian men or women that had it were little affected by it almost as little as if they only had small pox." Las Casas evidently had a marked penchant for corroborative work, as witness the following: "No credence is now given to the story told by Ferdinand Columbus and repeated by Las Casas that Columbus was educated in the University of Parvia."*

We feel a great deal is wanting in the nature of practical support of these several testimonies attributing the origin of the disease to the Indians. The brief descriptions left us of them indicate they lived a most natural life; mainly nomadic in only sparcely covered areas, hunting for their livelihood, and were of high moral standing. Contrast this with the congested masses of humanity of the old world, crowded into small areas, and, if later contemporary wood blocks, prints and descriptions are to be believed, living under the most indescribably filthy, immoral and squalid conditions, which were only par-

* Page 13, Voyages of Columbus, by Cecil Jane.

tially ended by a series of plagues and revolutions at a much later date. We should not fail to recognize, in this regard, that on the return of Columbus from the new world, syphilis was supposedly rampant amongst his crew, yet on his arrival home, when summoned in audience to give the Catholic Sovereigns an account of their voyage, no evidence concerning the very virulent disease that is supposed to have existed among them is to be found in the records of the Meeting at Barcelona. Documents only of a later composition teach us that "immediately thereafter the city began to be infected with the disease."

It will be recalled at this juncture that history has supplied us with the name of but one individual of the several crews who is occasionally recorded as suffering from this disease; that of Pincon of Palos. It would appear that under the circumstances the most pregnant discovery made in the Indies was that of an unknown and horrible disease. One fails to understand why this was not made the dominant keynote of Columbus' report. One might also wonder, considering the virgin soil of his crew, why the evidence among them was not perfectly patent to the receiving sovereigns, or why those "hawks" of the royal courts, the foreign ambassadors, whose main duty in reality was espionage, failed to report to their respective sovereigns the presence of this new and dreadful disease, which most certainly should have been apparent at this time and during the many months preceding its transmission to a French army in Italy. Records agree in the main that the epidemic of this new disease began in the army of Charles VIII of France, while invading Italy in 1495, and that its rapid spread was due to a scattering of that army because of the terror induced by the ravages of the disease. This is accepted; but that its incidence in that army was due to the enrollment of certain Spanish mercenaries who were supposed to have contracted it from the returned sailors of Columbus is rejected on the grounds of its inability to satisfy practical analysis.

In further considering the feasibility of this latter contention, it is essential that we possess some knowledge of the voyage of Columbus, more especially the circumstances surrounding his return. We should also possess some idea of the topography of the countries of the old world, so that we may study the very questionable mode of spread of this new venereal disease, which came to Europe by way of the sea and apparently spread through it by way of the land.

Columbus set sail from Palos on Friday, August 3, 1492. Land was sighted October 12, 1492. All that can be stated positively regarding this first landfall is that it was called Guanahani, and was, in all probability, the Bahamas. Columbus called it San Salvadore. He next cruised southward to Haiti where he landed on the 6th of December, and named it Espanola. The Santa Maria was wrecked on the 25th day of December, and Columbus was forced to return in the Nina. A blockhouse was erected from the wreckage of the Santa Maria, fortified, and named the Fort Nativity. And here, at their own request, forty men were left behind in January 1493. On the homeward voyage, Columbus experienced severe weather which on two occasions forced him into ports which were somewhat unwelcome to him; first at an island belonging to the Portuguese where the men he sent ashore were held prisoners for several days by the Governor. Columbus, with admirable intuition, refusing his somewhat pressing invitations to land, offered suitable arguments for the release of his men. Second, on approaching the coast of the mainland he was forced by another storm into the mouth of the river Tagus in Portugal. News of his successful voyage so aroused the chagrin of the Portuguese that at first, upon recommendation of the counsellors, he was assailed by the king who, "imputed that Columbus had been trespassing upon undiscovered dominions granted to the crown of Portugal by Pope Eugenius the Fourth." (Here is an

excellent example of what has been referred to elsewhere, namely, that the documentary evidence of the period was dictated by a few educated ministers, who would not hesitate to advance such naive claims as the above in order to gain their respective ends. It is from considerations such as these that one gains some small appreciation of the measure of their worth.)

When this pseudo-legal argument appeared to leave Columbus unruffled, some of the counsellors urged his assassination; but this was considered imprudent inasmuch as it was recognized that they could not keep the knowledge of his return from Spain. Moreover, they were in no situation to offend the Castile sovereigns at this time. He was finally invited to Court, entertained and made much of at Lisbon. He was also given an audience by the Queen before sailing for Spain on the 14th of March, 1493. He arrived in Palos on the 15th of March, 1493. Meanwhile, the Pinta had been driven into Bayonne, France, by the same storm. There they were entertained and the commander, unaware that Columbus had made a safe landing, sent messages to the Spanish Court concerning his own arrival. Leaving Bayonne, the Pinta reached Palos on the evening of the same day upon which Columbus arrived. Columbus next went to Seville, from thence he proceeded to Barcelona for an audience at the Court. Insofar, then, we may assume that the disease was brought from the Americas in two ships, one of which landed in France, the other in Portugal. After a certain lapse of time they proceeded to Spain.

We have no evidence concerning any new or abnormal disease demonstrated by the crew of the Nina on her arrival in Portugal; neither is anything to be found concerning a new disease following her departure. And inasmuch as the Portuguese were most envious of the Spaniards, it is to be expected that they would have been quick to manifest anything that would serve to detract from the glamour of this most momentous voyage. The same contention might safely be made of the crew of the Pinta, which landed at Bayonne in the south of France. We must also try to understand that only Spain apparently was infected, and that irrespective of the virgin soil receiving it, so little was this unknown disease dreaded, that when Columbus returned to the Americas some five months later, he was accompanied by 17 ships and 1500 men. We are to further believe that there was apparently a latent period of almost two years before it manifested itself sufficiently to be recognized officially when it was first noted in Italy. Yet, within approximately four or five months following its introduction into the organization of Charles VIII, the disease assumed such vicious proportions as to cause the utter route and demoralization of this victorious army. Assuming the crews of the Nina and Pinta to have had syphilis, it would seem logical to presume the primary foci of infection in Europe to be in France and Portugal, not Spain, and that the resultant spread in the old world would be by way of other seaports, the more especially when we recognize that these foci were situated on the coasts of the busiest waterway in the world, and that the great preponderance of trade was by way of the sea. This somewhat warrantable evidence seems to have been overlooked by many contemporary historians who have apparently devoted themselves to the beaten tracks of manuscripts laid down for them by past masters in the art of diplomacy many years ago. Indeed, it is as incredible as it is impossible that this disease should have existed for some three years in the seaports of France, Portugal and Spain without being carried to the other several countries of the old world possessing coastwise ports. Many Greek, British, Egyptian and Moorish vessels were trading in the Mediteranean between 1493 and 1496, yet according to the historical records, they conveyed no new disease to their respective countries. Syphilis apparently pursued an orderly and chronological spread, thus: Italy in 1494;

Germany, France and Switzerland in 1495; Holland and Greece in 1496; England and Scotland in 1497; Hungary and Austria in 1499. An inland mode of spread only possible with its origin in an army, and by no means compatible with the original European foci in the seaport towns of Lisbon, Bayonne and Palos!

And now reverting to more recent times: From a somewhat exhaustive research by Williams on the subject of the determination of syphilis by means of lesions found in ancient bones, it would appear that a single finding is in order: The fact that there exists a peculiar scarcity of ancient bones manifesting syphilitic changes in Europe, and while this fact could well be attributed to the vagaries of the disease, it is to be noted that this finding, upon which one could most fairly attribute the origin of the disease to the Americas, is a negative one. Conversely, many bones have been unearthed on this continent of undoubted antiquity apparently manifesting syphilitic changes, and this has largely been the foundation upon which those attributing the origin of the disease to the Americas have built. It has, at least, the merit of tangibility, which cold, unemotional logic renders null and void inasmuch as it is generally admitted that the disease, frambesia or yaws, which was undoubtedly endemic on this continent, produces bone lesions indistinguishable from those of syphilis. This excellent and extensive work is, therefore, none the less faulty in the sense of its being admitted as proof of the American origin of syphilis.

This presentation will have fully accomplished its purpose if it but serves to accentuate a fallacy that is apparently common to most of the histories of syphilis. They seem to be concerned, primarily, with attributing the spread of the disease to some one of the several peoples of the earth. It could well be described as the "vis a tergo" of the history of syphilis. It would appear but few diseases have been so signally honored and one gravely suspects the cause lies in the complete dominance of all thought of the early ages by its few autocratic intellectuals when syphilis was considered an unmoral visitation rather than a disease. The tenacity of established custom and thought is well demonstrated when it is recognized that in this, the twentieth century, the same somewhat futile endeavors sporadically continue.

When one recognizes that the clinical manifestations of the disease concerned are legion and that its etiological factor was neither known nor visualized until recent times, it becomes difficult to accept the dictum of its early spread from a few governed documents of the fifteenth century. The pages of history in general almost warrant the creation of an axiom, viz: "those who were least able to repudiate the stigma of anything were visited with it," and it would appear that syphilis has borrowed a page from history.

While it cannot be denied that historical findings must largely be made from a preponderance of ancient documentary evidence, one respectfully submits that when it is questioned rather than supported by practical analysis, it is vastly in order to consider it most critically, as it cannot be gainsaid much of the value of the writing of the period concerned lies in its artistry rather than its integrity; which was too often largely governed by both civic and international policies.

It would be well, therefore, to consider all that has been written heretofore as being merely a questioning of the several data regarding the early spread of syphilis, built for the most part upon the shifting sands of documentary works of medieval composition.

The matter of blame for the dissemination of a disease which was apparently universally believed to be a "visitation from God because of certain sinful acts" naturally became a subject of no small degree of controversy between the civilized nations, as witness its many given names, and this in all probability continued until such time as one of the more astute among

them realized that the visit of Columbus to the outside world coincided so well.

When we consider the records of perhaps the most ancient of civilized peoples, we find a similar uncertainty existing as regards the early spread of syphilis, inasmuch as no little controversy has obtained between the Asiatic peoples regarding its origin, or rather its initial appearance. There are several Japanese works extant which affirm that the disease was unknown until the sixteenth century, and most of the Chinese authorities agree that syphilis was unknown in China before the Ming dynasty. Li Shi Chen, author of the Pen T'soo Kang Mu states that the disease syphilis was prevalent between 1488–1521,* yet chancres were mentioned as early as the seventh century, A.D., under the names of "tu ching sore" and "yin shih sore." The following clinical descriptions are worthy of repetition: "The yin shih sore may be due to uncleanliness after sexual intercourse; if neglected it will get worse. The sore is very painful; there may be painful micturition like that of gonorrhea and the testicles may be inflamed. After ten days the sore is foul with pus and blood, and the flesh is eaten away. There may be continuous bleeding. It then becomes a chancre"—this from the "Essence of Surgery" written by Chi Te Chih, approximately 1335 A.D.†

The most conclusive evidence of the existence of syphilis in China in olden times, however, is found in a work entitled "The Thousand Gold Remedies"‡ "A tu ching sore is a sore on the prepuce, just behind the corona in men, and on the labia in women. It is depressed and painful, and looks like a chancre. A chancre is not painful." Both descriptions are undoubtedly those of soft or mixed chancres, but the profound significance of the concluding sentence admits of no ambiguity and is only equalled by its terseness. It informs one that the primary sore of syphilis, which is the only sore extant that is painless, was known, and the soft sore was to be differentiated from it largely because it was painful. This latter work was published in the seventh century.

It would appear that the ancient Chinese differed in no whit from their European colleagues, in that they undoubtedly confused the generalized manifestations of syphilis with that universal malady leprosy, and failed to realize their connection with the primary sores. The scholars of the much later Ming Dynasty recognized this relationship and believing it to be a new disease named it "yang mei."

Let us confine ourselves hereafter to that part of the history of syphilis which is legitimate, thus restricting ourselves to a simple recital of the periods with their several advances in our knowledge of this disease. The fallacy of estimating the standing of medicine in general as being of a very high order during the earlier periods concerned should be guarded against. It must be recognized that many of these findings were not generally known, much less adopted for many years following their discovery, and while admitting that clinical acuity of observation of the past was, in the main, superior to that of today, excepting in rare instances, it must be emphasized as being the much more recent past than we are at times led to suppose. A more adequate conception of the average standing of medicine of the periods concerned might be obtained if judged by the description of certain of the commoner medical practices in vogue by the leading practicing physicians.

Fracastorius described a disease and named it syphilis in 1521, published in 1530.

1506–88.	Fernell recognized the necessity of a primary inoculation.
1672.	Willis described general paresis of the insane.
18th century.	Lancisi recognized the relationship of aneurysm and syphilis.
	Morgani recognized visceral lesions.

* Pen T'soo Kang Mu, vol. 18, p. 49.
† Vol. 1, p. 12.
‡ Vol. 24, pp. 13 and 14.

19th century. Hunter decided upon the similarity of venereal lesions following self-inoculation.
Fournier stated syphilis the only cause of tabes.
Wallace established the contagiousness of secondary lesions of syphilis.
Ricord differentiated between hard and soft chancres, and made manifest the difference between syphilis and gonorrhea.

1905. Schaudinn and Hoffman discovered the Spirochaeta pallida.

1908. Wassermann reaction discovered.

1910. Ehrlich discovered 606 and later related compounds.

1914. Wyle proved rabbits could be positively inoculated with paretic cerebral tissue.

1918. Wagner Juarez utilized the malarial plasmodium successfully in the therapy of neurosyphilis.

1925. Kyrle used malaria in early syphilis with excellent result.

1930. Noguchi found Spirochaeta pallida in paretic brains.

A detailed bibliography is unwarranted, much of the matter concerned has been taken from various sources through the years. Whenever possible, in case of quotation an inclusion or footnote guide is given, this being proof of recent reference. The Asiatic matter was taken from "History of Chinese Medicine" by Wong and Wu.

BOOK REVIEWS

RADIOLOGIC EXPLORATION OF THE MUCOSA OF THE GASTRO-INTESTINAL TRACT. By The Cole Collaborators. Saint Paul, Bruce Pub. Co., 1934.

The subject of this monograph was assigned to Dr. Cole by Professor Béclère, President of the Third International Congress, and enabled Dr. Cole to prepare a complete work correlating all his extensive studies and reproducing his finest pictures. This is a preeminent monograph giving the work of one of the ablest roentgenologists America has produced. It begins with a short history of the subject and covers the literature as well as the personal experiments and investigations of the author. The chapter on "Correlation and Evaluation of the Four Fundamental Findings Observed in the Exploration of the Gastro-Intestinal Mucosa" is in itself worth the price of the entire book.

This is a monograph which American medical men may well be proud of and one which should not only be in the library of every roentgenologist but should be thoroughly studied by everyone doing radiologic exploration of the mucosa of the gastrointestinal tract.

DISEASES PECULIAR TO CIVILIZED MAN, Clinical Management and Surgical Treatment. By George Crile, M.D., N. Y., Macmillan Co., 1934.

Whether 100 per cent right or not, it cannot be denied that Dr. Crile's works have been among the most stimulating productions of modern medical science. The present work is an elaboration of the Ether Day Address given at the Massachusetts General Hospital in 1910 and of the address given before the American Philosophical Society in Philadelphia in 1910.

The principal diseases considered in this book are hyperthyroidism, neurocirculatory disorders, peptic ulcer and diabetes, all being diseases seen largely or exclusively in the human race.

The author is a keen student of both heredity and environment and his book is worthy of study by every progressive physician and surgeon.

THE SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM. By George E. Gask, M.D., and J. Paterson Ross, M.D. Balt., William Wood and Co., 1934.

The authors have presented in less than 200 pages a concise and yet complete study of what they call "the intriguing problems of the Sympathetic Nervous System." The book gives a full description of Anatomy and Physiology together with the details of operations with references for further research. The selection of cases and the necessity for careful consideration of the underlying clinical problems are stressed. Every surgeon doing this kind of work will be interested in this book.

SURGERY OF A GENERAL PRACTICE. By Arthur E. Hertzler, M.D., and Victor E. Chesky, M.D. St. Louis, C. V. Mosby Co., 1934.

Like all of Dr. Hertzler's books, this is thoroughly practical in character. Written from a vast personal experience, it is based on the author's book on "Minor Surgery" published in 1930. The change in title is explained by the logical fact that nothing is minor, at least from the patient's point of view.

For the general practitioner called upon to do occasional surgery, this book will be found of very definite help.

THE COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION: Vol. XXV (Papers of 1933—published 1934). Edited by Mrs. Maud H. Mellish-Wilson and Richard M. Hewitt, M.D. Phila., W. B. Saunders Co., 1934.

The new volume of Mayo Clinic papers, like the previous volumes, is a distinct contribution to surgical literature. There are 443 articles in all; of these 114 are printed in full, 21 are abridged, 40 are abstracted, and of 268 only the titles are given. It is readily understood that it would require almost a system of surgery to publish all the papers of this active clinic. The material has been well edited and every up and coming surgeon will want the book in his library.

THE DOCTOR AND CITIZENSHIP. By Thurman D. Kitchin, M.D. Boston, Christopher Publishing House, 1934.

The President of Wake Forest College, in North Carolina, has collected in a little volume of less than 100 pages his papers, most of which appeared in *Southern Medicine and Surgery*. As might be expected from a college president, a keen insight is portrayed in the articles which will make interesting reading for the medical profession as well as for the intelligent layman.

CLINICAL MISCELLANY. The Mary Imogene Bassett Hospital, Cooperstown. Springfield, Ill., Charles C. Thomas, 1934, Vol. 1.

This is an interesting collection of papers presenting work done at the Mary Imogene Bassett Hospital, Cooperstown, New York. There are 22 papers covering both medical and surgical conditions showing evidence of real clinical research.

INTERNATIONAL CLINICS, Phila., J. B. Lippincott Company, 1934, s. 44, vol. 2.

The new volume of the International Clinics is quite up to the previous standards of this Series. It contains the following articles on surgery all of which are interesting and up-to-date:

Operative Shock, By E. Rehn, M.D., Freiburg, Germany; The Anterior Lobe of the Pituitary Gland, The Thyroid Gland and the Carbohydrate Metabolism of the Liver, By Hermann Eitel, M.D., and Arnold Loeser, M.D., Freiburg, Germany; Concerning the Broadening of the Indications for Operation in Exophthalmic Goiter Through the Recognition at the Bedside of a Secondary Thyrogenic Injury to the Liver, By Erich Schneider, M.D., Freiburg, Germany; Operative Collapse Therapy in the Treatment of Pulmonary Tuberculosis, By Ralph C. Matson, M.D., and Ray C. Matson, M.D., Portland Oregon; Indications for Surgical Treatment of Peptic Ulcer; Methods; Postoperative Complications and Sequelae and Their Treatment, By I. W. Held, M.D., and A. Allen Goldbloom, M.D., New York City; The Medical and Surgical Aspects of Peptic Ulcer, By William Francis Rienhoff, Jr., M.D., and Benjamin M. Baker, Jr., M.D., Baltimore, Purpura Hemorrhagica, By L. R. Payne, M.D., and R. C. Whitehead, M.D., Norfolk, Virginia; Estimating the Extent of Disability, By Earl D. McBride, M.D., Oklahoma City; The Crippled Hand, by Isidore Cohn, M.D., New Orleans.

THIS MONTH'S CONTRIBUTORS

BALCH, JAMES F., M.D., Indianapolis.
Asst. in Urol., Ind. Univ. Sch. Med.; Vis. Urol., St. Vincent's & Methodist Hosp.; Attend. Urol., Indianapolis City Hosp.

BALDWIN, JAMES F., M.D., F.A.C.S., Columbus, O.
Founder, Surg. & Chief of Staff, Grant Hosp.; Cons. Surg., Children's Hosp.; Cons. Obst., White Cross Hosp.

BUCKLEY, E. J., M.D., N. Y.

BUGBEE, HENRY G., M.D., F.A.C.S., N. Y.
Attend. Urol., St. Luke's Hosp. & Lawrence (Bronxville) Hosp.; Urol., Woman's & Lying-in Hosp.; Cons. Urol., Mountainside (Montclair), Muhlenberg (Plainfield), Vassar Bros. (Poughkeepsie), Mather Mem. (Port Jefferson) Hosp.

CAMPBELL, H. SUTHERLAND, M.D., C.M., Los Angeles.
Assoc. Prof. Dermat., Univ. So. Calif.; Lect. in Dermat., St. Vincent's & Good Samaritan Hosp.; Chairman, Subcommittee, Skin & Mouth Tumors, Calif. Cancer Comm.

CHARACKE, HERMNA, M.D., Bklyn.
Clin. Asst. in Surg., Cumberland Hosp.; Clin. Rad. Therap., Bklyn Cancer Inst.

CLARK, HAROLD E., M.D., N. Y.

CORYLLOS, POL. N., M.D., F.A.C.S., N. Y.
Prof. Clin. Surg. & Assoc. in Surg. Research, Cornell Med. Coll.; Attend. Surg., Metropolitan Hosp., Dept. Thoracic Surg.; Thoracic Surg., Cornell Clin. & Broad St. Hosp.

COUNSELLER, VIRGIL S., M.D., M.S., F.A.C.S., Rochester, Minn.
Div. Surg., Mayo Clin.; Asst. Prof. Surg., Univ. Minn., Mayo Found.

DICKINSON, ARTHUR M., M.D., F.A.C.S., Albany, N. Y.
Attend. Surg., Mem. Hosp.; Jr. Surg., Child's Hosp.; Cons. Surg., Stamford Hosp. & Mem. Hosp. Greene Co.

DROSIN, LOUIS, M.D., N. Y.
Attend. Gynec., Beth David Hosp.

EASTON, EDWARD RAYMOND, M.D., F.A.C.S., N. Y.
Asst. Surg., Broad St. Hosp.; Act. Asst. Surg., Knickerbocker Hosp.; Clin. Asst. Gynec., Bellevue Hosp.; Clin. Asst. Surg., Polyclinic Hosp.

ERDMANN, JOHN F., M.D., F.A.C.S., N. Y.
Attend. Surg., N. Y. Post-Grad. Hosp.; Cons. Surg., Gouverneur, Greenwich, Mt. Vernon, Yonkers, St. Luke's (Newburg), & Nyack Hosp. & Home for Incur., N. Y. C., etc.

FOWLER, W. FRANK, M.D., F.A.C.S., Rochester, N. Y.
Attend. Surg., Highland Hosp.

GALLOWAY, CHARLES EDWIN, M.D., Evanston, Ill.
Assoc. Obst. & Gynec., Northwestern Univ.; Assoc. Obst. & Gynec., Evanston Hosp.

GRATZ, CHARLES MURRAY, M.D., N. Y.
Asst. Orth. Surg., N. Y. Post-Grad. Hosp.

HARLOE, RALPH F., M.D., PHAR.D., F.A.C.S., Bklyn.
Instr., Dept. Surg., L. I. Coll. Med.; Asst. Attend. Surg., L. I. Coll. Hosp.; Assoc. Attend. Surg., Kingston Ave. Hosp.

HECKEL, NORRIS J., M.D., Chicago.
Clin. Asst. Rush Med. Coll.; Assoc. Urol. Surg., Presbyterian Hosp.; Urol., Ravenswood Hosp.

HEISE, HERMNA A., M.D., Milwaukee, Wis.
Dir. Lab., Columbia & Children's Hosp.

HEYD, CHARLES GORDON, M.D., F.A.C.S., N. Y.
Prof. Surg., Columbia Univ.; Dir. Surg., & Attend. Surg., N. Y. Post-Grad. Hosp.; Cons. Surg., Woman's Hosp.

HOERNER, M. TISCHER, M.D., PH.D., Rochester, Minn.
Fellow in Surg., Mayo Found.

JENNINGS, W. KENNETH, M.D., Evanston, Ill.
Clin. Asst. in Surg., Northwestern Univ.

JEWETT, EUGENE L., M.D., N. Y.
Mem. Staff, N. Y. Post-Grad. & Reconstruction Hosp.

KRETSCHMER, HERMAN L., M.D., F.A.C.S., Chicago.
Clin. Prof. (G.-U.) Surg., Rush Med. Coll.; Urol., Presbyterian & Children's Mem. Hosp.

MALINIAK, JACQUES W., M.D., N. Y.
Attend. Surg., Sydenham Hosp.; Vis. Surg., Beth Israel (Newark) Hosp.; Cons. Plastic Surg., St. Peter's (New Brunswick) Hosp.; Author: Sculpture in the Living, N. Y., 1934.

MURPHY, DOUGLAS P., M.D., F.A.C.S., Phila.
Res. Fellow, Gynecean Hosp. Inst. of Gynec. Res., Sch. Med., Univ. Penn.; Instr. in Obst., & Gynec., Sch. Med., Univ. Penn.; Asst. Gynec., Presbyterian Hosp.

ROBISON, RICHARD P., M.D., N. Y.
Asst. Orth. Surg., Broad St., Metropolitan Hosp. & Clin.

ROGERS, S. PERRY, M.D., San Juan, Puerto Rico.
Zone Surg., Maryland Cas. Co.; Cons. Orth. Surg., Presbyterian Hosp.

RUBENFELD, SIDNEY, M.D., N. Y.
Clin. Asst. (Vis.) in Rad. Therapy, Bellevue Hosp.

RUND, EMMET H., M.D., St. Louis.
Asst. Gynec. & Obst., St. Louis Univ. Sch. Med.; Obst., St. Anthony's Hosp.; Vis. Gynec. & Obst., St. Louis City Hosp.; Mem. Staff, St. Mary's Hosp. & Firmin Desloge.

SAITO, MAKOTO, Prof. Dr., Nagoya, Japan.
Prof. Surg., Chief, 1st Surg. Clin., Nagoya Med. Univ.

SCHILLER, WALTER, M.D., Vienna, Austria.
Clin. Path., 2nd Women's Clin., Univ. Vienna.

SIEGLER, SAMUEL L., M.D., Bklyn.
Assoc. Obst. & Gynec., Bklyn Women's Hosp.; Asst. Surg., Kings Co. Hosp.; Diplomat, Am. Bd. Obst. & Gynec.

STELLHORN, CHESTER E., M.D., Bklyn.
Asst. Res. Surg., Cumberland Hosp.

TANNER, ERNEST K., M.D., F.A.C.S., Bklyn.
Chief Attend. Surg., Bklyn Hosp.; Prof. Clin. Surg., L. I. Med. Coll.

WOOD, CORNELIUS B., M.D., Boston.

The American Journal of Surgery

PUBLISHED MONTHLY BY PAUL B. HOEBER, INC., 76 FIFTH AVENUE, NEW YORK, N. Y.
FOR THE AMERICAN JOURNAL OF SURGERY, INC.

Editor: THURSTON SCOTT WELTON, M.D., F.A.C.S., NEW YORK

EDITORIAL BOARD

WALTER C. ALVAREZ, *Rochester, Minn.*; DONALD C. BALFOUR, *Rochester, Minn.*; CARL BECK, *Chicago*; ALEXIS CARREL, *N.Y.*; JAMES T. CASE, *Chicago*; ISIDORE COHN, *N.O.*; W. B. COLEY, *N.Y.*; FREDERICK A. COLLER, *Ann Arbor*; GEORGE W. CRILE, *Clev.*; ELLIOTT C. CUTLER, *Boston*; LOYAL DAVIS, *Chicago*; ROBERT V. DAY, *Los Angeles*; CHARLES A. ELSBERG, *N.Y.*; C. R. G. FORRESTER, *Chicago*; H. DAWSON FURNISS, *N.Y.*; JOHN H. GIBBON, *Phila.*; EMIL GOETSCH, *Brooklyn*; DONALD GUTHRIE, *Sayre, Pa.*; A. E. HERTZLER, *Kansas City*; C. GORDON HEYD, *N.Y.*; LOUIS J. HIRSCHMAN, *Detroit*; J. M. HITZROT, *N.Y.*; EMILE F. HOLMAN, *San Francisco*; R. H. JACKSON, *Madison*; JOHN E. JENNINGS, *Brooklyn*; W. L. KELLER, *Washington*; HOWARD A. KELLY, *Baltimore*; THOMAS J. KIRWIN, *N.Y.*; ARTHUR KRIDA, *N.Y.*; A. V. S. LAMBERT, *N.Y.*; E. M. LIVINGSTON, *N.Y.*, H. H. M. LYLE, *N.Y.*; JEROME M. LYNCH, *N.Y.*; URBAN MAES, *N.O.*; ROY D. MCCLURE, *Detroit*; HARRISON S. MARTLAND, *Newark*; J. TATE MASON, *Seattle*; RUDOLPH MATAS, *N.O.*; H. C. NAFFZIGER, *San Francisco*; E. W. ALTON OCHSNER, *N.O.*; CLARENCE R. O'CROWLEY, *Newark, N.J.*; F. R. PACKARD, *Phila.*; ROBERT L. PAYNE, *Norfolk, Va.*; LOUIS E. PHANEUF, *Boston*; E. H. POOL, *N.Y.*; DOUGLAS QUICK, *N.Y.*; HUBERT A. ROYSTER, *Raleigh*; A. C. SCOTT, *Temple, Tex.*; M. G. SEELIG, *St. Louis*; J. BENTLEY SQUIER, *N.Y.*; GEORGE W. SWIFT, *Seattle*; GRANT E. WARD, *Balt.*; F. C. WARNSHUIS, *San Francisco*: A. O. WHIPPLE, *N.Y.*; J. H. WOOLSEY, *San Francisco*.

Foreign Collaborators—GREAT BRITAIN—J. H. WATSON, *Burnley*. FRANCE—G. JEANNENEY, *Bordeaux*. ITALY—R. BASTIANELLI, *Rome*.

The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIALS

REPORTS AND RESOLUTIONS

THE other day we overheard part of a conversation between several physicians. One gentleman asserted it was a sheer waste of time for physicians to attend committee meetings (usually long, windy affairs), get hot under the collar over this and that, and spend hours writing detailed reports. "Whatever becomes of them?" was asked. "They are put on file, gather dust, and in time are forgotten."

The majority of those present either had no opinion on the subject, or did not agree with the speaker.

All of which prompts us to inquire: Last spring the N. Y. Academy of Medicine brought out a report on the maternal mortality in New York City for three years. It criticized certain current practices and offered suggestions aimed to better conditions. This report aroused a storm of criticism, abuse and debate. At least, it started physicians thinking. The New York Obstetrical Society appointed a committee to study the report, and this committee published its conclusions. This report, also, caused quite a flurry in certain medical spheres.

At the spring meeting of the American College of Surgeons a long list of recommendations was offered and adopted. It aimed at aiding the white collar worker who might get sick in these times of depression. Shortly after the College met, the American Medical Association had its

annual meeting. At that meeting, another set of resolutions was voted. From an entirely different angle these aimed at a solution of the same problem. There was much talk. You either lined up with Organized Medicine or the College. For several weeks, physicians discussed these proposals. At least they caused discussion and made many of the profession conscious of problems which they had not thought of before.

We are now well into the fall. We hear no more about the maternity problems, nor the American College of Surgeons' plans, nor the American Medical Association's set of resolutions. Any day now we need not be surprised if a brand new plan, a new and novel way to reach an Utopian state, is offered us. The season is always open.

Meanwhile the reports and resolutions and plans adopted last spring which caused a proverbial mental upheaval in our ranks, are filed away on dingy shelves and are gathering the dust of time.

A well known layman, nationally known for his accomplishments, called the whole business, "The ultimate in futility."

We wonder.

A QUERY

THE following is a copy of a letter received. The writer requested that his name be omitted.

"We read in the newspapers that in a certain western state a child of some thirteen or fourteen years was attacked and raped by a degenerate, a full grown man. The criminal was apprehended, tried, found guilty and sentenced to a long term in prison.

"The child became pregnant. The father of the little girl requested that his daughter be aborted. The usual medical consultation was held and two worthy physicians reported they could find no legal reason for terminating the pregnancy.

"Yes . . . I know you and thousands of other physicians can think of a dozen legal reasons why this child should not bring such a child into the world—the father a criminal degenerate, and the pregnancy the result of rape.

"But this is what I ask you or any physician who is a father, especially of a daughter or daughters: If your little girl, a child of fourteen years, was attacked and raped by an inhuman monster, called a man, and became pregnant, what would you do? Would you sit by and let her bring this unwanted baby into the world, or would you quietly and secretly have her aborted? I know what I'd do, and I wouldn't look far to have the operation performed by the best the profession has to offer. The idea of all this hocus-pocus when thousands of criminal abortions are done every month in this country, and very little is done about this appalling state of affairs.

"I've never done even a therapeutic abortion in my life. But I know what I would say and do if such a little girl was brought to me. Do you agree?"

What would be your answer?

Subscribers to The American Journal of Surgery *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*